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JPRS Report

Nuclear Developments

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JPRS-TND-88-010 *23 MAY 1988*

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French Radioactive Waste To Be Buried in Abomey

51000016 London AFRICA ANALYSIS in English 1 Apr 88 p 1

[Text] Paris. French radioactive waste is to be buried in central Benin under a closely guarded agreement concluded by senior members of the French and Benin governments.

The first shipment is set to leave France between 15 and 20 April aboard a new coastal patrol boat which a Beninois crew will take charge of over coming weeks. The vessel, flying the Benin flag, is now anchored in the northern French port of Brest, having completed sea trials. Aboard is the captain, navy lieutenant Bere-Prosper Kiando, a cousin of Benin's head of state, Mathieu Kerekou, and Colonel Seraphim Noukpo, a military official who will supervise the loading and ensure the safe arrival of the nuclear waste.

In terms of the deal, Benin will accept the French nuclear waste for disposal by deep burial in exchange for a guarantee of 30 years' special financial and economic assistance. Details of the deal are unknown outside a very narrow circle, and even Kiando and Noukpo are only aware of the broad outline.

Kerekou has decided that the waste will be buried on the outskirts of Abomey, near the village of leading opposition figure, Michel Aikpe (Africa Analysis, No 41) who died on 21 June, 1975 while apparently in the company of Kerekou. The Abomey region is one of the centres of opposition to Kerekou.

/9274

SOUTH AFRICA

Uranium Re-exported to Soviets

51000015b Johannesburg THE STAR in English 21 Apr 88 p 11

[Article: "SA Uranium 'Re-exported' to Soviets"]

[Text] Luxembourg—South African uranium had been re-labelled by a Luxembourg firm for re-export to the Soviet Union to get round an embargo imposed by that country, a member of parliament claimed here yesterday.

Ecologist deputy Mr Jup Weber told a news conference that the firm, named Nulux, a subsidiary of West Germany's Nukem GmbH, had changed the certificates of origin on a uranium consignment to show that it came from Niger.

The material was eventually re-exported to the Soviet Union, which had an embargo on imports of South African uranium.

Officials from Nulux were not immediately available for comment.

A spokesman for Nukem in West Germany said the information was "all wrong".

He declined to go into details.

Mr Weber said he had obtained documents showing that Nulux and Nukem had arranged to import a consignment of South African "yellow cake" (uranium oxide).

He said that the uranium was sent to the Soviet Union for enrichment before being re-exported for use in nuclear power stations in West Germany.—Sapa-Reuter.

/12223

North Coast Spotlighted for Nuclear-Station Study

51000015a Pretoria THE PRETORIA NEWS in English 21 Apr 88 p 12

[Article: "North Coast Spotlighted for Nuclear-Station Study"]

[Text] Durban—Eskom announced here yesterday that it plans to conduct studies this year and next year along the Natal North Coast, between Port Dumford and Salt Rock, to establish whether suitable sites for future nuclear power-stations could be identified.

The studies are part of an ongoing, long-term programme designed to identify sites that can be considered for power-station development.

Eskom chief executive Mr Ian McRae said: "I must stress that these investigations are totally divorced from any specific nuclear power-station construction programme."

Mr McRae said a final choice of sites for construction purposes would be made only when the decision to continue the nuclear programme was taken.

-From Cape Town it is reported that politicians have reacted cautiously to news of the planned Eskom investigation.

The representative for the area, MP Mr Renier Schoeman (NP, Umhlanga), yesterday accepted the need for the investigation but warned he would be watching Eskom "every inch of the way".

Mr Mike Ellis MP (PFP, Durban North) queried why the area has been selected at all when there are major alternative power sources in Natal, namely coal.

He said, however, that the problems resulting from the use of coal, which was causing acid rain in the Transvaal, had to be weighed against the dangers of nuclear energy.

/12223

Utilities Reportedly Offsetting Nuclear Research

51200024 Toronto THE GLOBE AND MAIL in English 31 Mar 88 p B9

[Article by Robert Sheppard]

[Text] With the federal government progressively reducing its commitment to nuclear research in Canada, provincial utilities, especially Ontario Hydro, have been stepping into the breach.

However, the new financing arrangements are changing the nature of the research being done by Atomic Energy of Canada Ltd. and slowing the development of the next generation of Candu reactors, the agency's chief administrator said.

"Research into the next generation of Candu has been the principal casualty of this program," Stanley Hatcher, president of the AECL Research Co., said in an interview. "We have had to divert efforts from this" to the more immediate kind of work that its new backer, the provincial utilities, want done.

The three provincial utilities that operate Candu reactors—in Ontario, Quebec and New Brunswick—have reached an agreement to give AECL nearly $40-million in research and development funds this year, a substantial increase from their normal contributions only a few years ago.

But because this money is given on the condition that it be matched dollar for dollar by AECL, these utilities now effectively control about 30 percent of the federal agency's research budget of about $260-million.

The largest user, Ontario Hydro, with 16 of the 18 Candu reactors currently in operation in Canada, is underwriting about 95 percent of this arrangement and so it is essentially calling the shots on much of the new research it wants to back up its existing reactor system.

Nevertheless, Mr. Hatcher said he is extremely pleased with the substantial new levels of provincial support for AECL. The new money has helped stabilize the research organization in the midst of five years of federal budget cuts, he said.

These cuts have led to a staff reduction of about 15 percent, including the loss of several senior physicist who went south to participate in President Ronald Reagan's Strategic Defence Initiative, and also to a shift in some research priorities, Mr. Hatcher acknowledged.

A few years ago, AECL was deeply involved in a long-term program to study the recycling of nuclear fuel rods to alleviate the problem of storage, but this has been "pretty well canceled," he said.

In 1985, the federal government announced that by 1990 it would halve the $200-million it was then allocating to nuclear research. This progressive reduction of funds created a crisis of sorts for AECL Research last year when it found itself $25-million short of the money it needed to pay for its planned research program.

A request for help from the Ontario Government was turned down for political reasons. But the province's largest Crown agency, Ontario Hydro, came to the rescue, albeit with some strings attached.

Two years ago, Ontario Hydro was giving AECL about $5-million a year as part of a fairly minor agreement with Quebec and New Brunswick for specific research projects.

Last year, when the financing crisis hit, this was increased to $26-million. It is to go up to $34-million this year, nearly a sevenfold increase in a two-year period.

(On top of this, Ontario Hydro also carries out about $40-million worth of nuclear R&D in house annually, according to documents obtained under Ontario's new freedom of information law, so its commitment to the Candu program remains substantial and its effectively on the increase.)

Ottawa still provides the lion's share of the AECL research money, with about $340-million budgeted for fiscal 1988-89.

/9738

Tour Reinforces Essex Concern About Fermi Reactor Safety

51200025 Windsor THE SATURDAY WINDSOR STAR in English 26 Mar 88 pp A3, A4

[Article by Scott Burnside]

[Excerpts] A tour of the Fermi II nuclear reactor by local politicians has only added to their belief that it poses a threat to Essex County residents.

"There are some serious problems with the plant," said New Democrat MP Steven Langdon shortly after he returned from the Monroe, Mich., plant.

After a frank question-and-answer session with Detroit Edison officials, Langdon said the plant's vice president admitted there are problems in three out of 10 areas in which the plant is tested: training, maintenance and surveillance testing.

"That tells me there is a problem," Langdon said. "We have a plant that is certainly not up to scratch."

But Langdon and fellow New Democrat MP Howard McCurdy said Detroit Edison officials didn't object to the suggestion that a committee made up of both Canadian and American experts monitor the plant. Anti-Fermi II groups and politicians have been lobbying for an independent monitoring team for months. But External Affairs Minister Joe Clark has said the Atomic Energy Control Board of Canada (AECB) can rely on its American counterparts the Nuclear Regulatory Commission (NRC) for reports on the plant.

Langdon said if such a committee is formed it will be important to include representatives from other than the two agencies since they seem to have a "pact" that prevents mutual criticism.

Instead, Langdon said he would like to see experts from Canadian universities and independent energy groups involved.

The two MPs were joined on the tour and discussion by Conservative MP Jim Caldwell and representatives from a number of government agencies including Health and Welfare Canada, Emergency Planning Canada, External Affairs, Environment Canada and the AECB. The presence of these groups, said Langdon, should provide additional ammunition in forcing Clark to make a formal request for a third party investigation.

Media were barred from the tour after a request from External Affairs, which set up the meeting.

The 13-member Canadian delegation met with Detroit Edison officials before touring the plant. They then met privately with NRC representatives although McCurdy had to leave before this meeting. While Langdon and McCurdy said they were impressed with the candor of the responses by Detroit Edison officials, Langdon said the NRC was "much more defensive about an outside, neutral review."

"Because they see that as their job."

The plant is in the midst of a routine shutdown and McCurdy said it is hoped the plant can deal with some of those problem areas before it goes back into operation in two to three months. McCurdy said they were told these problems don't "significantly" hamper the safe operation of the plant.

Fears raised by citizen's groups on both sides of the border claim the plant is accident-prone and since prevailing winds are in the direction of Essex County, is a threat to its residents.

The lone local MP who did not attend was Liberal Herb Gray, who said the tour was set up without anyone consulting him. Gray was in Windsor presiding over a task force on trade as part of this weekend's Liberal convention.

Nonetheless, Gray said he questioned the value of this type of briefing since it wasn't open to the media.

"I'm not going to go there to be a mouthpiece for Detroit Edison and the Nuclear Regulatory Commission," said Gray.

The Windsor-West MP has been critical of the relationship between the NRC and the Canadian energy board saying we take for granted what the NRC reports. Gray has been lobbying Clark to expand the International Joint Commission's powers to monitor the nuclear plant. The IJC attempts to resolve environmental problems involving the Great Lakes.

/9738

HONG KONG

Daya Bay Nuclear Plant's Implications for Hong Kong Cited

Emergency Measures

51400007 Hong Kong SUNDAY MORNING POST in English 21 Feb 88 p 1

[Article by Sa Ni Harte]

[Text] An emergency hotline linking Daya Bay and the Hongkong Royal Observatory is one of the major contingency measures recommended in case of nuclear accidents when the power plant starts up in 1992.

British consultants compiling the Government-commissioned report, due to be released next month, have ruled out an evacuation plan for Hongkong's 5.6 million residents.

The report says such a plan is not necessary because the nuclear plant is 50 km from Hongkong and worldwide radial distances for nuclear-accident evacuation were about 25 km.

Evacuation was necessary only in a 10 km vicinity of the immediate site, the report says.

Other contingency plans deemed not necessary in the report include:

—The need to store iodine to counter the effects of radiation poisoning.

—The construction of special shelters to guard against possible nuclear fall-out and radioactive plume that could be travelling in the air in the event of leakage.

Emergency measures suggested in the report include mobilizing about 16 Government departments such as the police, Fire Services, Water Supplies, Agriculture and Fisheries and Civil Aid Services if a nuclear accident occurred.

The ability of departments such as Agriculture and Fisheries to check farm products for radiation, Water Supplies to monitor reservoirs to ensure safety of drinking water, the police to maintain social order and the Municipal Services Branch to test imported food already was considered adequate to handle a nuclear emergency.

Once an increase in radiation levels was detected and an alert put through the Daya Bay-Hongkong hotline, the Hongkong Government could immediately implement a monitoring system for food and water supplies against possible nuclear contamination.

The report by the Harwell-based United Kingdom Atomic Energy Authority is emphatic on the need to monitor the traffic of produce, especially from China, so the public can be assured food is not radioactively contaminated.

At present, foodstuffs accounts for about 14 per cent of Hongkong's imports from China.

The report also focuses on ways of monitoring the territory's radiation levels in drinking water.

It says any radiation which might leak from the plant would not contaminate Hongkong's reservoirs—even those closest to Daya Bay such as Plover Cove and High Island—because the fallout would be diluted by the large amounts of water.

Thus the local water supply should be safe, the report says.

The safety of the drinking water was also safeguarded by the advance filtering systems employed by reservoirs, it says.

The proposed measures were made based on the likely amount and scope of radiation that would be released in the event of a nuclear accident.

The contingency measures would be tested by the Government a year before the power plant came into operation in 1992 to ensure that the various departments were all geared up for an emergency.

The report will be the first study on Daya Bay to be made public. Earlier ones by the UKAEA on radiation, education strategies and accident assessments, remain confidential despite strong public objection.

The nuclear plant, estimated to cost $28.8 billion, will have two 900-mega pressurized water reactors and is a major energy project being undertaken by a Sino-foreign joint venture.

Construction of the plant was suspended on September 14 last year after it was discovered that 316 of the 576 bars of reinforcing steel rods for the foundation raft of a reactor were missing from the base.

Consultative Body

51400007 Hong Kong SOUTH CHINA MORNING POST in English 5 Mar 88 p 2

[Article by Chris Yeung]

[Text] China's long-awaited plan to set up a consultive body in Hongkong on the Daya Bay nuclear power plant will be announced in May, a senior Chinese official disclosed yesterday.

Mr Li Hou, a deputy director of the Chinese State Council's Hongkong and Macau Affairs Office, said the nuclear Industry Ministry would ask the Guangdong Nuclear Power Joint Venture Company to Set up the Advisory body.

The Guangdong-Hongkong joint venture will tap local experts on nuclear power, through the New China News Agency in Hongkong, to sit on the consultative body.

However, details on the powers and duties of how such a body will monitor the nuclear plant remain unclear.

The formation of a consultative body to monitor the controversial Daya Bay plant received wide support in Hongkong after efforts by anti-nuclear forces to shelve the project failed.

Chinese Acting Premier, Mr Li Peng, had earlier promised to set up a consultative body comprising Hongkong people to monitor the plant's operation.

But it was understood that plans were stalled because of strong opposition from nuclear power officials in Beijing.

The officials were said to be adamant that any consultative body should only have the power to air views but not to monitor the building of the plant and its future operation.

The monitoring role is solely a matter with the Nuclear Safety Ministry under the State Council.

Mr Li said he had not idea if the future consultative body should directly give their views to the nuclear ministers under the State Council and how the relation between the consultative body and the joint venture company would be.

The fact that the consultative body is to be set up through the joint venture company indicates that it might not be given a high status.

Mr Li declined to give further details, adding he was not in charge of nuclear affairs.

His colleague, Mr Lu Ping, said the consultative body "was not under any ministries" in Beijing.

A Legislative Councillor, Mr Wong Po-yan, who has been pressing Beijing to set up the consultative body, said he believed it should be directly under the Nuclear Industry Ministry.

He was also confident that Legislative Councillors would be included in the consultative body.

Mr Wong, who is a co-convener of the economic subgroup of the Basic Law Drafting Committee, is in Guangzhou to attend a coordinating group meeting. Group members include co-conveners of other subgroups, secretaries-general such as Mr Li and Mr Lu and two vice-chairmen of the drafting body.

They are to polish a draft of the Basic Law to be released for public consultation after the seventh full meeting of the Basic Law Drafting Committee.

07310

Report Ready on Daya Bay Nuclear Emergency Measures

51400009 Hong Kong SOUTH CHINA MORNING POST in English 7 Apr 88 p 3

[Article by Andy Ho]

[Text] The long-awaited consultancy report on contingency planning for nuclear accidents will be tabled in the Executive Council on Tuesday.

The emergency measures, recommended by the Harwell-based United Kingdom Atomic Energy Authority, will be made public shortly after they have been seen by the Governor's top policy advisers.

The Harwell report is not expected to contain any surprises because major findings have already been leaked to the media to lower public expectations on evacuation procedures.

Government officials insist that Hongkong does not need an evacuation procedure because it is 50 kilometers from the Daya Bay nuclear site.

Instead, it will focus on monitoring radiation levels, prevention of contamination of food and water supplies and safety procedures to follow in the event of an incident.

The Harwell authority was commissioned to advise the Government on how the territory should react in the unlikely event of a major mishap at the Daya Bay nuclear power plant.

Copies of the Harwell report will be distributed to members of the Legislative Council, the 19 district boards, public libraries and other concerned institutions.

It will also be released to the news media and later put on sale at Government publication centers.

A principal assistant secretary with the Economic Services Branch, Mr John Wilson, said the Government intended to make the British consultants' findings available to all interested parties and individuals.

The English version of the report is now ready but it will take another week before the Chinese translated version is completed. The document will then be released simultaneously in both languages.

The Government will print 5,000 copies of the report and more will be printed if necessary.

07310

JAPAN

Technology Minister Wants To Stem Antinuclear Trend

51600032 Tokyo KYODO in English
0625 GMT 13 Apr 88

[Text] Tokyo, 13 April KYODO—State Minister for Science and Technology Soichiro Ito Wednesday called on the nuclear power industry to stem a growing citizens' movement against nuclear energy.

There must be a response to views which neglect economic activity, call for complete halt of nuclear power, or allege without scientific basis that nuclear power is dangerous, Ito told the opening of the Japan Atomic Industrial Forum's 21st annual conference.

Ito, who also serves as chairman of the Atomic Energy Commission, urged the 1,250 representatives of the nuclear power industry to mount public information campaigns to deter further opposition to nuclear energy.

Development of the industry and a secure energy supply are necessary if Japan is to maintain an affluent standard of living in the 21st century, he said.

In February around 3,000 citizens opposing a power modulation test at Ikata nuclear plant on the island of Shikoku staged Japan's largest antinuclear demonstration since the 1986 Chernobyl nuclear station accident.

Last year nuclear energy provided 32 percent of Japan's electricity. Government planners expect the share to increase to 40 percent by 2000.

Ito also pledged that Japan would meet its international responsibilities regarding nuclear nonproliferation by increasing efforts to ensure nuclear materials are not diverted for use in weapons.

Legislation delineating responsibility for protection of nuclear materials by electric power companies and transporters and establishing punishments for violators is currently before the Diet, Japan's parliament, he told the audience, which included 108 participants from 26 foreign countries and four international organizations.

He predicted that the U.S. Congress would pass by the end of the month a Japan-U.S. nuclear cooperation agreement that would allow tons of plutonium recovered from U.S.-supplied fuel to be transported to Japan.

The agreement would replace a current case-by-case procedure approving such shipments, and has been opposed by members of Congress who say it weakens U.S. nonproliferation policy and poses safety concerns if the plutonium is transported by air.

The meeting will address nuclear cooperation in Asia, prospects for nuclear power development and other topics before ending Friday.

/12913

ROMANIA

Problems With Candu Construction in Romania Described

51200023 Toronto THE GLOBE AND MAIL in English 17 Mar 88 pp B1, B4

[Article by Edward Greenspon]

[Text] Bucharest—A decade after Canada last peddled a nuclear reactor overseas, a hard-headed approach by the Romanian Government keeps pushing completion of the show-case project further and further into the future.

Despite extreme shortages of electricity, Romania is placing more importance on going it alone in the development of a Candu reactor than on getting it done. As a consequence, there is little relief in sight for the severe power rationing that requires people to use no more than 40-watt lightbulbs and to wear overcoats in their homes.

A frustrated Atomic Energy of Canada Ltd. also finds itself caught in the squeeze. It was hoping by now to be able to point to an operating power plant in Romania as a demonstration to other countries of the Candu's prowess in even the most difficult circumstances.

The reason for the snail's pace of work on the reactor at Cernavoda, located on the bank of the Danube River, 150 kilometres east of the capital, can be traced to the country's uncompromising campaign to pay off its foreign debt. The Romanians are determined to make as many of the complex Candu parts as possible themselves—saving on import costs, but causing long delays.

Some components are fabricated four or five times before Romanian industry gets it right.

Officially, Romanian authorities insist the first unit at Cernavoda will be generating electricity by this summer. But Canadians working on the project counter that there is no way.

"Right now, 1992 is a very optimistic date for the first unit," said John Karger, Canada's resident engineering manager. (Romanian authorities refused to permit a visit to the site.)

The discrepancy appears to arise from the unwillingness of anybody in the know in Romania to risk the wrath of President Nicolae Ceausescu by telling him that one of his prestige projects is so far behind schedule. When a Canadian executive innocently mentioned a 1990s date in a meeting with the President last May, Mr. Ceausescu got visibly upset and then treated it as a translation error.

"Nobody has the temerity or gall to tell him otherwise," a senior AECL official complained.

So instead of setting a realistic completion date, the Romanians keep pushing it back three months at a time, making planning virtually impossible. Completion of the first unit would add a badly needed 6 per cent to the country's electricity production.

From its inception, the Candu project has been cursed by a series of misfortunes, many of which illustrate the difficulty of doing business in this highly centralized economy. Canadians complain of poor management practices, low worker morale, slow decision-making, incomprehensible lines of authority and shifting political priorities.

Control of the Cernavoda site rests entirely with the Romanians. Fourteen Canadians simply provide technical advice.

Mr. Karger, who managed construction of a Candu reactor in Argentina, said that besides the drive to self-sufficiency, the major cause of delay is the Romanian refusal to provide incentives for workers or managers to meet their targets.

Canada and Romania first began discussing a nuclear power program 20 years ago. After delays because of floods and an earthquake, a contract was finally signed amid great fanfare in 1978.

Canada was encouraged enough about the long-term prospects of the relationship to establish an embassy in Bucharest, mainly to service the nuclear deal.

At one point, the Romanians were holding out the carrot of building 20-reactors at $1-billion a shot, but that has been steadily clawed back. Officials of the state energy and electricity department now speak in terms of 12 reactors over time.

But Romania will supply 90 per cent of Candu parts domestically after the second unit at Cernavoda, they added.

Although the Canadian industry won't have as much gravy to sop up as hoped, AECL will still receive a small royalty payment on future units in exchange for having taught the Romanians the ins and outs of Candu technology.

When the contract was signed, Canada extended $1-billion of credit to the Romanians. So far, orders worth slightly more than $300-million have been placed with AECL and other Canadian companies.

Even that business didn't come easily. Well after the deal was struck, Romania informed Canadian suppliers that purchases would be paid for with Romanian products rather than cash.

The Canadian companies were outraged, but ultimately acceded to this barter arrangement. In return for their nuclear equipment, they received everything from shoes to furniture to steel to frozen strawberries, all of which had to be resold by international trading companies.

The Cernavoda project suffered another setback in 1982, when Romania fell behind its payments to other creditors. Canada's Export Development Corp. suspended loan guarantees for nearly one and a half years.

More importantly, the humiliation of having to account to international bankers had a searing effect on the chauvinistic Romanians. Mr. Ceausescu decreed that his country would not again be beholden to external forces.

He launched a painful program to pay off the country's foreign debt, which entailed, among other things, the reduction of imports to the bare bones. Nuclear components that were supposed to be bought overseas now would be made at home.

And so the project got further bogged down as Romania's unsophisticated industries tried to master new processes and techniques in place of Canadian suppliers.

According to Mr. Karger, the Romanians make 2.5 end fittings for each one that merits quality standards. He thinks it would have worked out cheaper for them to have imported them.

In the case of plugs for these end fittings, the Romanians tried and tried to make them domestically, but finally had to turn back to a Canadian supplier.

"In their drive to save money, they are being penny-wise and pound foolish," said Vladmir Socor, a Romanian analyst at Radio Free Europe.

There is concern in some circles that this penny-pinching could have serious consequences once the nuclear plant is up and running. Critics worry that Romania's reluctance to invest hard currency in maintenance and spare parts might pose safety problems.

The Romanians bristle at the suggestion. "In the nuclear field, we cannot afford making a deviation from quality," said Dumitru Stoian, counsellor for the minister of nuclear issues.

In fact, he said that at some point Romania will be accomplished enough in nuclear technology to join Canada as an exporter of Candu. The Romanians are pressing AECL hard for access to recent advances in Candu technology.

Although the Romanian nuclear deal hasn't proved the bonanza once anticipated, industry officials insist it has been profitable to Canada, especially considering AECL's 10-year sales drought.

Asked to specify the net benefit, Ian Smith, AECL's project manager, conceded it hasn't earned "great gobs of money" for anybody. "It's a good contract for us and I wouldn't want to go any further."

It would, however, be an even better contract, company officials added, if it ever gets completed.

/12223

ARGENTINA

CNEA Asked To Cut Budget 70 Million Australes

PY062134 Buenos Aires CLARIN in Spanish 6 May 88 p 16

[Text] Yesterday the Finance Secretariat asked the National Atomic Energy Commission (CNEA) to slash this year's budget by 70 million australes. This figure is less than expected, and what is left will allow the nuclear plan to continue, according to CNEA officials.

Dr Renato Terigi, CNEA financial manager, explained that the budget proposed by the Finance Ministry is tantamount to "a commitment to maintain the budget at an agreed-upon level, as well as to maintain a flow of resources from the Treasury that will make it possible to continue construction of Atucha II and the Heavy Water Industrial Plant. [quotation mark as published]

Secretary Mario Brodersohn said: "We will continue negotiations to expand external financing." Brodersohn will meet with CNEA President Ema Perez Ferreira to sign the agreement papers.

Apparently, the FRG has made an offer which, if it materializes, will supplement funding from the Treasury, or exceed such funding. The CNEA will thus be able to keep its two most important projects moving so that they will be completed on schedule. The completion date for the third nuclear electricity generating plant is the second half of 1993.

The CNEA has admitted that during the first 4 months of this year, payments to local contractors have fallen behind as a result of financial difficulties. However, it was noted that this situation is likely to improve as the Treasury normalizes the transfer of funds. Also, SEGBA [Greater Buenos Aires Electrical Service], which owes the CNEA 300 million australes for electricity supplied from the Atucha I and Embalse nuclear plants, paid a portion of its debt yesterday.

As for the external resources, everything indicates that negotiations can now move faster. The CNEA head and some aides will travel to the FRG next week. From these negotiations might emerge an organizational reform in which ENACE (Argentine Nuclear Enterprise for Electricity Power Plants) would be involved.

Nuclear Cooperation Accord Signed With Turkey

PY031906 Buenos Aires TELAM in Spanish 1801 GMT 3 May 88

[Text] Buenos Aires, 3 May (TELAM)—This afternoon Argentine International Relations Secretary Susana Ruiz Cerutti and Turkish Ambassador in Argentina Gunduz Tuncbilek signed a cooperation agreement for the peaceful use of nuclear energy.

According to the information released by the Argentine Foreign Ministry, this is a framework agreement that encompasses several specific areas of cooperation in the peaceful use of nuclear energy ranging from development of nuclear reactors to the training of technical and professional personnel.

The accord also deals with production of fuel elements, prospecting for the exploitation of nuclear minerals, security at nuclear installations, and basic research.

As far as training of technicians and professionals goes, the accord establishes scholarships and provides for the creation of joint working groups and the exchange of information.

The accord will be implemented by the Argentine National Commission for Atomic Energy (CNEA) and the Turkish Atomic Energy Authority (TAER).

CNEA Leader on Nuclear Construction Delays

PY271821 Buenos Aires TELAM in Spanish 1155 GMT 27 Apr 88

[Text] Buenos Aires, 27 Apr (TELAM)—Emma Perez Ferreyra, the National Commission for Atomic Energy (CNEA) chairperson, has stated that it is becoming very difficult to finish large undertakings, such as the Atucha II plant, which will generate nuclear electricity. She warned that if the Atucha II plant is not finished on time, consumers will not be able to use the 745 megawatts that this plant is designed to produce and thus the national electricity demand will not be met.

Perez Ferreyra added that the Atucha II plant should have been in operation by June 1987. The nuclear plan is at a crossroad: It either continues, or it will fail because if we are unable to finish Atucha II, it is senseless to finish the heavy water plant.

Although she denied that the construction of the nuclear plant has stopped, she said it is being carried out inefficiently because when resources are not freely available, there cannot be any efficiency.

Perez Ferreyra asserted that the CNEA had requested $700 million in its 1988 budget, which had been previously approved by the finance secretary and is now awaiting congressional approval. She explained that if the works are to be finished, Atucha II will need $1 billion and the heavy water plant will need $150 million.

In a statement to newspaper "EL CRONISTA COMERCIAL," Perez Ferreyra said that in keeping with an Argentine decision, we are building a heavy water plant to ensure an independent supply of essential operational supplies for a nuclear power plant which uses natural uranium and heavy water.

Asked about CNEA salaries, she said that a scientist with many years of experience earns 3,000 australes and a newly recruited scientist earns 1,800 australes. She added that private companies pay double that amount and that a scientist of the same level earns more than double at some state-run companies, such as the Water and Energy Company, and that this is why they leave the CNEA.

BRAZIL

Lack of Funding May Halt NUCLEBRAS Program

51002022b Sao Paulo O ESTADO DE SAO PAULO in Portuguese 12 Apr 88 p 37

[Text] The Brazilian nuclear program which NUCLEBRAS has been developing since 1975 and which has involved expenditures of more than $4 billion may be suspended this year. Licinio Marcelo Seabra, the president of NUCLEBRAS, said yesterday in Sao Paulo that there will be no other alternative unless the government alters the budget of 20 billion cruzados allocated for 1988. He said that this sum, which was projected in September of last year based on an inflation estimate of 60 percent per year, was the equivalent of $400 million. "Today, however, it represents less than $80 million. Therefore the program will have to be suspended if the budget is not revised. After all, the obligatory cost of the domestic and foreign debt service will come to about $60 million this year.

A request for a revision was submitted, Seabra said, and is being studied by officials in the government financial sector. The NUCLEBRAS program has nothing to do with that being pursued in Ipero by the CNEN. "These are different projects. Ours has to do with the Angra I, II and III Plants and the transfer of technology from Germany for the enrichment of uranium up to 3 percent, using the centrifugal jet system (to produce fuel for nuclear-electric power plants). The Ipero project was designed for initial enrichment of 5 percent, using small quantities for a fuel intended foruse in laboratories and small reactors."

NUCLEBRAS will have difficulty in obtaining an expanded budget this year, Seabra admits. A polemic issue since the beginning, the program is behind schedule, and unless the resources are increased, it cannot be continued. In 1974, when the agreement with Germany was signed, eight nuclear plants were contemplated. Of these, only Angra was completed, but it soon became known as the "firefly" because of its inconsistent performance. For the time being, it is shut down.

Angra II, which was to begin operation in 1983, has fallen 10 years behind schedule and is not expected to be in operation before 1993. "This is an absurdity. But nothing can be done without resources. The problem is financial, and not technological." In addition, there is a uranium enrichment unit in Resende, Rio de Janeiro, still in the experimental stage, and $30 million will be needed to complete the analysis phase, the president of NUCLEBRAS said.

The state body has sent concentrated uranium ore to France and Germany for transformation into gas, enrichment and processing into pellets.

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Joint Nuclear Program Said Not Subject to IAEA

Official Says Nuclear Goals Peaceful

51002022a Sao Paulo O ESTADO DE SAO PAULO in Portuguese 9 Apr 88 p 8

[Article by Rivaldo Chinem]

[Text] The cooperation program signed by the presidents of Brazil and Argentina does not contain any provision for the use of nuclear energy for war, "at least at present," but the country is not submitting its technology to the International Atomic Energy (IAEA) in Vienna, which exercises control over the weapons of the world. This is "based on a political decision," according to a statement made in Ipero, Sao Paulo, yesterday by Adm Henrique Saboia, the naval minister, following the ceremony held to inaugurate the Aramar Experimental Center.

A veritable land barrier prevented demonstrators from approaching, in a kind of "war operation." But Presidents Jose Sarney and Raul Alfonsin arrived in Ipero by Brazilian Air Force (FAB) helicopter. The delegation arrived at 0920 hours, and the background music which was being played at the Adm Alvaro Alberto Unit, which was being inaugurated, was the "Song of America" by Milton Nascimento, followed by "The Brothers" by Atahualpa Yupanqui and "Dream With Serpents" by the Cuban Silvio Rodriguez.

Rear Adm Othon Pinheiro da Silva, president of the Special Projects Coordination Group (COPESP), explained that the isotope enrichment unit was the product of work by scientists and technicians in the Navy and the National Nuclear Energy Commission (CNEN), with the support of researchers at civilian, military and industrial centers. He went on to explain the nuclear fuel cycle to an audience including the two presidents and Ministers Bayma Denys, Luiz Henrique da Silveira, Renato Archer, Abreu Sodre and Henrique Saboia.

The presidents and the delegations accompanying them then attended a cocktail party held in another hall in connection with the inauguration of the center. The press was barred. Only officials wearing the red and black badge, such as Governor Orestes Quercia and physicist Rex Nazareth, president of the CNEN, were allowed in.

The authorities then toured the Adm Alvaro Alberto Unit, the plant where the uranium isotope enrichment takes place. Once again, the press was not allowed to accompany the visitors. On their return, another explanation was provided by Adm Othon Pinheiro da Silva to the presidential delegation and journalists, who were separated by a railing and surrounded by innumerable security agents. This time Othon mentioned the demonstrations protesting against the installation of the Aramar Experimental Center. "Minority groups in our society do not want us to have technological development, but these demonstrations remind us of those individuals who hoard small amounts of food for the future, under pressure from members of their families who are only thinking of the present. The individuals who think in this way are mistaken."

A small sample of enriched uranium was shown to the presidents of Brazil and Argentina. Presidents Sarney and Alfonsin together unveiled the inauguration plaque at the Aramar Experimental Center and signed the Ipero Declaration, a joint statement on the nuclear policies of the two countries. In this document, they reiterated their conviction about the importance of nuclear development for the economic and social development of their peoples, and reasserted their inalienable right to develop their nuclear programs for peaceful purposes without restriction. Furthermore, they noted the commitment made by the two nations at the time of the visit paid by President Sarney to the uranium enrichment plant in Pilcanyeu, Argentina, and again during President Raul Alfonsin's current visit to Ipero.

The ceremony ended with the signing of this document at 1053 hours. Only Argentine photographers were allowed access to the FAB helicopters in which the dignitaries departed for Sao Paulo, while Brazilian moving picture and still photographers protested in vain. While balloons were being released—blue and white in salute to Alfonsin and yellow and green, bearing his name, for Sarney—journalists awaited the arrival of Adm Henrique Saboia, the naval minister, who was the only member of the presidential committee to give an interview. Neither of the two presidents spoke before the microphones. "Brazilians need to believe that the government has decided on the use of nuclear energy for peaceful purposes," Minister Saboia said. "The Ministry of Navy is considering the development of a nuclear submarine as a distant goal, but it must be made very clear that only the propulsion system will be nuclear." Saboia went on to explain that the propulsion system is used as a source of heat, and that the nuclear submarines will be propelled by steam-operated turbines. "For the time being," he added, "our purpose has nothing to do with war, but we will not submit our nuclear technology to the IAEA, based on a political decision. As to atomic submarines," he said in conclusion, "we have no plans or established date for their manufacture. We have a program which will lead us to that point. Who knows, I may be able to invite you to their inauguration in the future."

IAEA Will Not Inspect Plant

51002022a Sao Paulo O ESTADO DE SAO PAULO in Portuguese 9 Apr 88 p 8

[Article by Roberto Godoy]

[Text] Industrial installations such as that the Navy has in Ipero, or the laboratories of the Institute for Advanced Studies at the Ministry of Air Technical Aeronautics Center, both of which are involved in Brazil's parallel nuclear program, will not be subject to any kind of inspection by international control bodies. It is only the plants and equipment resulting from the cooperation agreement signed with Germany in 1975 which are periodically inspected by technicians from the IAEA.

This inspection was demanded by the authorities in Bonn during the negotiations preceding the signing of the treaty, and it "was accepted with great reluctance by the Brazilian military," according to the annual report of the IAEA, which is a UN body with headquarters in Vienna. It is maintained by contributions from the 111 member countries which total an estimated $120 million. According to Paulo Nogueira Batista, a former president of the NUCLEBRAS, "The terms of the safeguards adopted by Brazil are precise and do not threaten our sovereignty." It is this independence which allows the development of research within the autonomous program, thanks to which the nuclear fuel, its residues, destination and practical use can be kept secret, just as the technological solutions for which the Nuclear Energy Commission has opted are.

The delegation accompanying Argentine President Raul Alfonsin saw none of this yesterday. Nor did the group which accompanied President Jose Sarney to Pilcanyeu in 1987 obtain any new information. Nor will Argentina submit its atomic plan to the International Agency.

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Plasma Laboratory Will Research Nuclear Fusion Technology

Plasma Laboratory in Rio

51002021 Sao Paulo O ESTADO DE SAO PAULO in Portuguese 12 Mar 88 p 4

[Text] Rio de Janeiro—In Rio de Janeiro yesterday, Minister of Science and Technology Luiz Henrique and Governor Moreira Franco signed an agreement providing for an investment of $64 million over the next 4 years to establish the National Plasma Laboratory. The laboratory will research large-scale nuclear fusion technology and also make it possible to increase the number of plasma physics researchers in the country from the current 70 to 200 over the next 4 years.

Thanking Luiz Henrique, "without whom we would not be signing this agreement today," and Governor Orestes Quercia, who relinquished his claim to have the laboratory located in his state and thus avoided "a big quarrel," Moreira said that the municipality where the center would be located had not yet been chosen. According to Luiz Henrique, the agreement calls for an integrated effort by the government, the universities, and private enterprise: "It is a project for the entire country, with headquarters here in Rio de Janeiro, for developing the technology of controlled thermonuclear fusion, which is essential for the generation of energy and the country's scientific and technological development."

Investment of $50 Million

51002021 Brasilia CORREIO BRAZILIENSE in Portuguese 18 Mar 88 p 8

[Text] Rio de Janeiro—By the year 2000, Brazil may have developed methods for controlled nuclear fusion which could provide an inexhaustible source of energy. Research will be spurred by establishment of the National Plasma and Nuclear Fusion Laboratory, which will be set up over a period of 5 or 6 years and which will require an investment on the order of $50 million.

In listing the advantages of the new laboratory, Rio de Janeiro's secretary of science and technology, Jose Pelucio, praised the decision by the Ministry of Science and Technology to carry out the project in Rio de Janeiro. Pelucio feels that his state has satisfactory conditions for the expansion of high-tech industry, which, he says, will no doubt result from construction of the laboratory.

Together with the Ministry of Science and Technology, the Secretariat of State will set up a task force consisting of expert engineers to work out the characteristics of the laboratory and then decide where it will be located in the state. Jose Pelucio said that parallel "with the project for establishing the laboratory, the Ministry of Science and Technology is developing the National Plasma Program, which is aimed at encouraging studies in physics at research centers." That program, which is nationwide in scope, will require funds on the order of $20 million.

Tokamak Received at USP

51002021 Sao Paulo FOLHA DE SAO PAULO in Portuguese 9 Mar 88 p A-16

[Article by Cristiano di Giorgi]

[Text] Yesterday the Sao Paulo University Physics Institute (IFUSP) received a "tokamak," which is a device for studying plasma at high temperatures (see the text below), as a gift from the Italian Government. The tokamak will be disassembled and its parts used to build the TBR-2, a new tokamak that is more powerful than the one sent by Italy or the one that the IFUSP already has (the TBR-1, which is also the only one in Latin America). According to Prof Ivan Cunha Nascimento, director of the IFUSP and also a researcher in the area of plasma physics, the decision to disassemble the new tokamak and use its components to construct a more powerful one derives from the philosophy of the plasma group that has existed at the university since 1974. "We have always tried to guarantee mastery of all the steps in the technological process involved in the experiments we conduct. Training personnel who are familiar with the process as a whole is just as important as achieving new results. And all modesty aside, I believe we are succeeding."

The cost of building the new tokamak will be about $4 million, including construction of a new building. The cost would be much higher if the IFUSP did not already have a great deal of the necessary material. Besides the equipment from the Italian tokamak, the IFUSP has toroidal field generators (which use currents on the order of 50,000 amperes to produce the magnetic field) worth $2 million and a great deal of the necessary infrastructure. The $4 million will be obtained through the agreement between the IBD and the USP [Sao Paulo University].

Exchange

The IFUSP has also established a cooperation agreement with China for construction of the new tokamak. Now present at the IFUSP are researcher Wang Shohua, who is an expert in the building of tokamaks, and a woman researcher, Chen Yun-hui, who specializes in the computerization of data collection. Both are from the Plasma Physics Institute of the Chinese Academy in China. The program also provides for the sending of two Brazilian researchers to China before this year is out. According to Shohua, the exchange is very worthwhile to both countries, since China is more advanced in some areas, such as machine construction, and farther behind in others, such as electronics and plasma diagnostics. "We are teaching quite a bit and learning even more. This agreement is turning out to be more productive than we imagined," he said in conclusion.

Probe

It is precisely in one of the areas included by Shohua among those in which Brazil is more advanced—plasma diagnostics—that IFUSP researchers have just won an important prize in the United States: the IR-100 for 1987, sponsored by the U.S. magazine RESEARCH OF DEVELOPMENT, which honors scientific and technological discoveries considered by the magazine to be among the 100 most important during the year.

The achievement which was awarded the prize was the construction of an electrostatic ion probe that is used to measure the temperature and density of ions on plasma's periphery.

Space: Fourth State of Matter

Plasma is the fourth state of matter. People usually learn in school that there are three states of matter: liquid, solid, and gaseous. They do not normally know that 99 percent of all matter existing in the universe is in none of those three states, but in the plasma state. The matter making up the stars as well as that in interstellar space are in the plasma state, leaving only the matter existing on the planets for the three other states.

Plasma is the state of matter with the most energy. The state with the least energy is the solid state, in which the molecules of a substance are fixed. If we increase the amount of energy in a solid by adding heat, the moment will come when that solid will enter the liquid state (the melting point), and in that state some of the molecules can "slide" against the others. If even more heat is added, the gaseous state will be reached, with each molecule being completely independent and able to scatter indefinitely if not contained.

Thousands of Degrees

Plasma is obtained by heating the gas to temperatures of thousands of degrees Celsius, at which point the atoms lose their electrons, which are set free. In general, plasma is obtained not by using sources of heat but by applying electrical voltage, as in mercury lamps.

The study of plasma physics has already led to various technological applications such as high-precision metal cutting, the firing of furnaces, and microelectronics. But its great importance lies in the fact that knowledge concerning the behavior of plasma is essential for achieving controlled thermonuclear fusion, which is a cheap, abundant, and nonpolluting way to generate energy.

Tokamak

It is precisely in order to gain control of thermonuclear fusion that research is being done with the tokamak. If hydrogen isotopes are brought to temperatures on the order of 100 million degrees Celsius, their ions collide and produce heavier ions. Their collision results in the release of extremely high energy. The process is self-sustaining. That is how energy is produced in the sun. Unlike nuclear fission, nuclear fusion leaves no radioactive waste.

To maintain the necessary high temperatures, the plasma cannot be in contact with material objects—in other words, it must be confined, otherwise its energy is absorbed by the walls of the container. In the tokamak, that "confinement" is achieved by the use of magnetic fields, whose orientation forces the particle to follow a helicoidal trajectory (as though traveling along the spiral binding of a notebook) without hitting the walls of the tube.

The intention is to study the behavior of plasma at high temperatures through the use of optical spectrometers, microwave interferometers, probes, and lasers. The research is still in its initial stage. Researchers believe that if all goes well, large-scale commercial exploitation of thermonuclear fusion as a source of energy will not be possible before the year 2030.

IFUSP Director: No Place for Politics

51002021 Sao Paulo FOLHA DE SAO PAULO in Portuguese 9 Mar 88 p A-16

[Article by Prof Ivan Cunha Nascimento, 57, director of the Sao Paulo University Physics Institute]

[Text] The debate taking place in press interviews over the site of the National Plasma Physics Laboratory which may be established by the Ministry of Science and Technology has been characterized chiefly by its political aspects, with no regard for the stage of development in controlled fusion research in this country or abroad.

In the future (30 years from now or longer), controlled thermonuclear fusion may become a practically inexhaustible source of nuclear energy, with the advantage of being much cleaner and more ecologically acceptable than fission, which is the process on which today's nuclear reactors are based.

It is, therefore, important that research in the area of fusion also be carried on in Brazil, because if those reactors become viable, we cannot repeat what happened in the case of fission reactors, where the lack of a coherent and stable research program eventually led to the Nuclear Program. The decision to develop an autonomous nuclear program in the area of fission was made only after a delay of about 30 years.

The first fusion research efforts in Brazil date back to 1974, and the first equipment began operating in 1980. At present, the best structured groups are those at the USP, the INPE [National Institute of Space Research], and UNICAMP [Campinas State University].

The first plasma program was drawn up in 1978 without any government participation. The second program was established in 1982 by a commission of researchers appointed by the Ministry of Mines and Energy and the National Nuclear Energy Commission [CNEN] at the suggestion of a few scientists. That program was actually started with CNEN funds in 1982 and 1983. But because of the CNEN's priorities, the funds allocated were concentrated on other programs.

Last year, researchers brought the problem to the attention of Renato Archer, who was minister of science and technology at the time, and he appointed a new commission to draw up the fusion program and establish the national laboratory. Basically, the program as approved provides financial support for the projects at the universities, including a medium-sized tokamak for the USP,

the program for training personnel within the country and abroad, and the establishment by the Ministry of Science and Technology of a plasma laboratory where a plasma confinement apparatus would be installed.

Several areas in the states of Sao Paulo and Rio de Janeiro were considered as possible sites for the laboratory. The commission rejected some of them but did not express a preference for any of the others, and the problem of choosing a site was left to be solved following the appointment of a steering committee for the national program. The final recommendations submitted to the minister included approval of the projects at the universities, with the timetable for setting up the laboratory to be dependent upon approval of its location.

The estimated cost of the program is $64 million, depending on where the laboratory is established. Anticipated expenditures for the universities account for only about 20 percent of the total.

Deciding on a realistic timetable for carrying out the projects, especially that for the national laboratory, is an essential condition if they are to be successful. It does not seem practicable to install the national laboratory on a totally new campus, where it would also be necessary to establish an entire and expensive infrastructure, including civil construction, water, sewage, electric power, a library, supporting workshops, a restaurant, and so on within 4 years, that being the time frame announced, while simultaneously building the confinement facility and making it work. Anyone who has had experience with projects in the scientific area in Brazil is aware of the difficulties involved in carrying out experimental projects. In other countries, it takes from 5 to 10 years for projects to become operational, depending on their size.

Another aspect that needs to be considered is that the investment in the laboratory and especially the infrastructure is too expensive ($51.4 million) to justify using it only for the plasma laboratory. It would be justified if other research projects were concentrated on the same campus. Research funds are scarce in our country, and if they are allocated to one big project over a short period of time, there may not be enough money for others that are already underway. It is necessary that the expenses be rationalized through judicious planning.

The lack of qualified personnel for carrying out the projects is another factor limiting ambitious desires. The national program as approved includes a plan for training personnel at Brazilian universities and abroad, and obviously, if competent scientific personnel are not trained, there will be no one to keep the national laboratory going. The USP and UNICAMP have already trained about 50 plasma physicists who now hold doctorates or master's degrees. The total number of physicists (including postgraduate students) and engineers working with plasma in Brazil is 100, but that is still too few to carry out the projects within the time frames mentioned in the press.

The drain on the universities is another critical aspect of the establishment of a national laboratory. If it happens, it may make the laboratory impossible in the medium term. It should be noted that foreign universities will not be able to make up for that deficiency and that at least 5 years are required to earn a doctorate. Another factor to be considered is that it takes about 10 years to train a competent research group, and the dissolution of those groups would represent an irreparable loss.

All those factors show us that a political decision on the establishment and location of the laboratory without waiting for a technical study of the way in which it should be set up—a study carried out by a team of scientists possessing experience with projects and an overall view of the problems—cannot be accepted.

In our view, therefore, the necessary conditions for the success of the National Plasma Laboratory are—in addition to government financial support—the viability and scientific and technical competence of the team to be trained and realism in establishing that laboratory. There must be rationalization in the application of funds, whether those funds are provided through the budget or from loans, since both must be paid for with taxes paid by society.

Lastly, we want to point out that discussion has focused on the national laboratory while completely ignoring the national program, which also includes the universities. Unless the programs are established within the universities, we will run the risk of creating in the area of fusion research a program similar to the Nuclear Program, and that is unacceptable.

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History of Nuclear Parallel Program Surveyed

51002023 Sao Paulo ISTOE in Portuguese
13 Apr 88 pp 46-54

[Article by F. Fantini and R. Costa: "The Epic of Uranium"]

[Text] Between 1975 and 1988, Brazilians watched their country bury a mountain of money in the sands of Angra dos Reis, the Rio de Janeiro nature preserve that became a rathole into which was poured the bulk of the appropriations earmarked for paying for the nuclear agreement between Brazil and West Germany—a bill that already totals $6 billion. Of the eight reactors scheduled under the accord to be used to produce electricity, only one of the two planned for Rio has gotten off the drawing boards and been built—albeit only in skeleton form—and the day when the residents of Brazil's Southeast will plug their living room television sets into an outlet fed directly by the power plants at Angra is still a long way off. After all, Angra I, built outside the framework of the agreement, has spent more time under repair than sending electricity out along the Furnas transmission lines.

Compelled to live with the keen disappointments caused by prodigious projects that collapse inward even before they are ready, Brazilians last week received news of great technological importance, although obviously it was a modest gain when compared with the figures for the nuclear agreement. A uranium enrichment plant built by the Brazilian Navy, which invested $81 million in it, is now operating in the city of Ipero, 120 km from the capital of Sao Paulo State. Inaugurated Friday morning in a lavishly formal ceremony by President Sarney and the Argentine president, Raul Alfonsin, the Aramar Experimental Center will be able to produce 3 kg of 20 percent enriched uranium per year. It is a major leap forward for Brazil in the realm of nuclear energy.

This is the most visible result of an enterprise that came to be known as the "parallel nuclear program," the principal thrust of which is aimed at building a nuclear powered submarine during the coming decade. The name "parallel" comes from the fact that the entire initiative was conducted outside the boundaries of the Brazil-Germany Nuclear Agreement and was not monitored by the inspectors from the International Atomic Energy Agency, which controls the proliferation of nuclear weapons. Resorting to the confidentiality option that customarily surrounds national security operations, Brazil chose an alternative and independent route, using different scientific and technological procedures, marching in double time and skirting around the German package.

The story of nearly a decade of such parallel activity is only now beginning to come to light. Since last week, the contours of what the Navy was able to plan and accomplish—along with the agency from the nuclear energy sector, the research institute, and private domestic enterprises—have become clearer. This technological epic was played out by a generation of engineers and physicists who were virtually unknown to the public but who have become familiar, since the transition to democracy, to the stars who pontificated at the annual conventions of enthusiastic scientists.

The Manager of the Atom

The one who set up the plant at Ipero was Adm Othon Luiz Pinheiro da Silva, 49, a native of Rio de Janeiro with a very reserved manner. He graduated in engineering from the University of Sao Paulo and did 3 years of specialized studies at the renowned Massachusetts Institute of Technology (MIT) of Boston, where he earned his doctorate. In 1978, he was assigned by former Navy Minister Maximiano da Fonseca—then director general of nuclear material for the Navy—to write a report on the prospects of Brazil entering the era of nuclear submarines. "The Navy wanted to make 'feijoada' but we didn't even have the beans yet," recalls Adm Pinheiro da Silva now.

In this case, acquiring the beans meant mastering the fuel cycle, the technological process that starts with uranium in its natural state and ends when the tablets of enriched uranium consumed by nuclear reactors have been obtained. Brazil only had the capability to take the most basic step in this entire cycle—extract the uranium from the mines and make it into yellow cake. The selection of Adm Pinheiro da Silva to make the study was not mere coincidence. The year before, he had come back from his postgraduate studies at MIT as the first officer to have been trained by the Navy in the field of nuclear engineering. His resume included a year of study at Gibbs and Koxs, a New York company from which the Navy had purchased a ship design. Adm Pinheiro da Silva had also worked at the Division of Mechanical Workshops, coordinating the Navy 's frigate building program under which the first two units were built.

So he was not lacking in naval and nuclear experience, nor in enthusiasm for this field of endeavor. "I took advantage of my stay at MIT to get an extra master's degree in mechanical engineering, as a hobby," he says proudly. To consolidate his education he also made a study of the world energy balance and the situation in specific countries, a burning issue in those petroleum crisis years. Back in Brazil, he joined the Aviation Technical Center in Sao Jose dos Campos in order to participate in the experiments with the laser method of uranium enrichment. In 1979, Navy Minister Maximiano da Fonseca received the report he had asked for.

The Navy wasn't the only group eager to get going on an independent nuclear energy program then, at the turn of the decade. The project was of national security interest in another department. A working group composed of Luiz Eduardo Cerqueira, Glicerio Proenca and Luiz Alencar Araripe was busily engaged in a study of the nuclear issue in the National Security Council, CSN. Araripe had been assigned to the headquarters of the National Information Service, SNI, and reported directly to Gen Octavio Aguiar de Medeiros, then chief of that agency who was the only one with whom he discussed the nuclear problem. The CSN had already gathered sufficient evidence that the advanced countries in nuclear matters would not be willing to pass along their technology. More specifically, it was realized by then that the Brazil-Germany agreement would not give the Brazilians the procedure for converting uranium salts into uranium hexafluoride gas, which is the starting point for the vital enrichment process.

Pioneer Activities

On a Sunday in August 1979, Rex Nazare Alves, a physicist and then the executive director of the National Commission for Nuclear Energy, CNEN, received a phone call at home from Araripe. The CSN was suggesting that he accept an assignment to work on making an autonomous program viable. During a subsequent meeting with ex-President Joao Figueiredo, Nazare accepted the challenge. The autonomy option was reminiscent of

the pioneer spirit displayed by Adm Alvaro Alberto da Mota e Silva who in the 1950's had faced up to the foreign boycott of Brazil's attempt to set up its own nuclear program and who lent his name to the newly inaugurated plant at Ipero.

"At that time, in 1979, we had to bring all the domestic capabilities together in one effort, set well defined goals, yet leave room for expansion of individual motivations," recalls Nazare, who has been in charge at CNEN since 1982 and is its chairman. On the service record of this dedicated career official of the CNEN, now 50 years old, there is one item that certainly must have recommended him for the future task. He had transformed CNEN's Radiation Protection and Dosimetry Laboratory into an institution that enabled Brazil to be self-sufficient in radioactive solution gauging and is now recognized internationally by the AIEA as a standard for Latin America. During his 5 years there, he found himself in the dubious situation of having to come up with typically Brazilian solutions, knowhow that has served him in his new job.

At the Helm of the Program

Discreet and skillful, it was in area of political engineering, however, that Nazare showed his extraordinary ability. He managed to perform the feat of getting through the decade of the 1980's at the head of a program that, although turbulent, had to be kept moving along covertly and which provoked infighting within the government, international pressures, and even professional jealousies among the participants. As the country was about to enter the New Republic, several ministers were asking for the head of the CNEN chairman as a figure associated with the "ancien regime." In vain. Nazare won the support of President Tancredo Neves, who publicly announced his intention to keep him.

There was a third pair of hands on the helm by which the parallel program was steered to a safe harbor—those of Sao Paulo physicist Claudio Rodrigues, 49, superintendent since 1985 of the Institute for Nuclear and Energy Research, IPEN, headquartered on the campus of the University of Sao Paulo. He was responsible for pulling together the scientific experience that had been gathered, bit by bit, by IPEN's staff of respected researchers. Until the end of the 1970's, the knowledge stored up at that institution had been of a more theoretical nature. Rodrigues began to be interested in isotopic enrichment in 1973, while doing postdoctoral work in Pasadena, California. IPEN made use of the experiences of the researchers of the old guard of the 1950's—men such as Ivo Jordan, who taught courses in isotopic enrichment, or Alcidio Abrao, a chemist who conducted the first analyses of the uranium in Brazil that was found in monazite. "We had to redeem the good name of Brazilian intelligence," Rodrigues testified.

Bolted Doors

It was around this trio—Othon, Rex and Claudio—that the parallel program took shape. Its code name was Project Cyclone, a label chosen by the admiral that referred to the cyclone separator used in ships' boilers to separate water and steam. No effort was spared to keep the progress of the activities quiet. Justifying this, Nazare points out that: "The world market for enriched uranium is worth $50 to $60 billion, and no one wants to share with anyone else. The emergence of nuclear energy made it mandatory that we adopt a policy of silence."

The question or whether or not the closed doors were necessary was always a source of controversy. "There must be a comprehensive change in the decision-making process. A project of this magnitude must be approved in advance by the Congress and have clearly defined support from society," argues Rogerio Cezar Cerqueira Leite, a physicist who visited Aramar last Monday and was pleased with what he saw at the plant. In his opinion, secrecy is only justified as regards the technical details and the technology employed. "All countries do that," says Cerqueira Leite.

The blanket of secrecy covered everything—from the use of the appropriated funds to the description of materials used in making components. But the deadbolts slid even more tightly shut when questions were asked about the number, capacity and dimensions of the machinery installed to enrich uranium at the Aramar Experimental Center—the ultracentrifuges, symbol of the tremendous progress made by this country in 7 years of hard work. No country divulges those numbers, because they make it simple to figure out the stage of development reached and the degree of mastery of the technology. Sources in the energy sector interviewed by ISTOE last week revealed that there are 48 ultracentrifuges at Aramar. The information was given to members of the technical staff of Nuclebras—according to these same sources—by Rex Nazare himself, in executive session of an internal meeting held recently at the company's facility in Resende, where isotopic enrichment is being done by the jet-nozzle method.

The Dimensions of the Machine

Speaking at a closed session of the presidential Commission to Evaluate the Brazilian Nuclear Program, Nazare, as chairman of the CNEN, furnished data on the ultracentrifuge—again, this is what our sources in the energy sector told us. At the time of the meeting in early 1986, the rotating cylinder of the machine was 150 cm tall and had a diameter of 17 cm. The speed of the ultracentrifuge was 420 m per second, and it was expected to produce 600 grams of 20 percent enriched uranium in 1988. The meeting with the members of the commission was held at the Institute of Radiation Protection and Dosimetry, in the Barra da Tijuca district of Rio. When confronted in the wee hours of Thursday morning in Sao Paulo with the figures referring to number of ultracentrifuges, their

height, and diameter, Nazare categorically denied that he had twice given out this information. Specifically as regards the three numbers, the CNEN chairman said "I neither confirm nor deny them."

The journey to the achievement of an ultracentrifuge with industrial capabilities such as this one was arduous from those very first moments at the turn of the decade. Working with Rodrigues, Pinheiro da Silva began putting together the first team. It was handpicked and composed of seven engineers who are still working together today. After that, it was possible to give them a free hand. The program was begun on 2 February 1982—interestingly, the day dedicated to Iemanja. "The date brought us luck," jokes Adm Pinheiro da Silva. The goal set by the Navy of building a nuclear submarine may seem very remote, but it made it possible to break the task down into stages and make a list of very specific objectives to be won.

Fission in the Reactor

The coveted submarine is moved by the propulsive force of nuclear energy—which is released during a nuclear reaction fueled by 20 percent enriched uranium. This reaction involves a change in the nucleus of the atom. Thus it differs from a chemical reaction that involves only the electrons that orbit the nucleus. A nuclear reaction is known as fission; the nucleus of a uranium atom breaks in two and sends out from two to three neutrons, each capable of causing the fission of another atom of uranium 235, i.e., in a chain reaction. A great volume of energy is released and this is reused to power the electrical generators of the submarine. The device in which this transformation of the uranium is accomplished is the nuclear reactor, a prototype of which the Navy plans to build on land, at the Aramar Experimental Center, by 1992. So there are two very tangible goals: the fuel and the reactor.

Richer Uranium

The seven-man team first attacked the problem from the fuel side. Brazil has the world's fifth largest reserve of uranium, estimated at 300,000 tons. Most of it—142,000 tons—is found in a mine at Itataia, in Ceara State. Next comes Lagoa Real in Bahia, with 96,000 tons. The deposit most mined so far is in Pocos de Caldas, which is also the site of the mill, built under the agreement with West Germany, that succeeded in obtaining yellow cake, the first stage in the processing. Almost all elements in nature are mixtures of several isotopes, i.e., atoms of the same element which have the same number of electrons and protons but differ in the number of neutrons that can be found in their nuclei. This means that isotopes differ slightly in their weight. Uranium is a radioactive element that occurs in nature as a mixture of two isotopes. One of them has a mass number of 238 and the other 235, i.e., 3 units less. In nature, 99.28 percent of uranium is of the former type and 0.71 percent is of the latter type. It is only the latter isotope (235) that is fissionable, i.e., capable of sustaining a nuclear chain reaction and having great importance in nuclear reactors and weapons. In order for this to happen, the uranium must be "enriched," which means increasing the presence of the lighter weight isotope 235 in the mixture as it is found in nature. This is exactly the target at which the parallel program was aimed.

There are basically four technologies that can be employed to separate the isotopes from the uranium. The first is known as gaseous diffusion; a gas containing uranium is forced through porous barriers that resemble membranes. The U 235, which is lighter, passes through more quickly. The second process is the jet-nozzle process. A mixture of uranium hexafluoride and hydrogen is forced at high speed to follow a circular trajectory. Both methods consume a tremendous amount of energy and are, therefore, not very economical. The jet nozzle, tested unsuccessfully by Nuclebras in its work with the Germans, is ridiculed among scientists who call it "nuclear fiction" (a pun on the word "fission") because it has proven to be of little use. The third method, involving the use of laser beams, requires further laboratory research, but looks very promising for the future.

Just Like a Mixer

Project Cyclone immediately opted for the fourth route: gas ultracentrifuges, a technology in which Brazil was then only a neophyte (see illustrations). Uranium hexafluoride gas (UF6)—which is whitish in color, looks like a cloud of talcum powder in suspension and contains both uranium isotopes—is placed in a closed cylinder whose wall rotates at speeds of 30,000 to 60,000 rotations per minute. (For comparison purposes, the turbine of a Boeing when it is poised on the runway for takeoff makes only 13,000 revolutions per minute). The difference in weight provides the basis for the separation of the two isotopes, i.e., through the action of centrifugal force the heavier uranium 238 is dashed against the wall of the cylinder while the lighter uranium 235 stays in its central portion. Collector tubes installed in the lower part of the centrifuge remove the uranium 235, and the uranium 238 comes out underneath. "It's like what happens in a food mixer, where the butter moves to the edges," physicist Rodrigues explains.

Among the main technical obstacles encountered in building a prototype of the ultracentrifuge in the IPEN laboratories was that the limits of the material used to make the rotating bucket, then made of metal alloys, were soon exceeded. "At first, the cylinders broke like glass when submitted to the tensions generated by the high-speed rotation," Pinheiro da Silva recounts. "It was discouraging." The team also faced a devastating enemy—the corrosive power of the uranium hexafluoride.

However, at the beginning of September 1982, in a very serious and solemn atmosphere, they conducted an experiment that turned out to be a landmark in the

progress of Project Cyclone. The group met at IPEN and attempted isotopic enrichment. Just to give the place the feel of a Third World laboratory, the electric power in the building failed. Success finally came at the end of a very tense day. "The spectrometer recorded the enrichment," recalls Rodrigues. The presence of fissionable uranium had increased by one-tenth, and the feat was celebrated with domestic champagne (Rodrigues still has the cork from the bottle) and beers at a bar near University City.

Private Support

Another souvenir of the occasion was kept for the annals of Brazilian science: a sample of uranium hexafluoride which is still in the archives. "From then on, we conducted at least one experiment every day, even on weekends, and that gave us a wealth of data," notes Pinheiro da Silva. Little by little, we developed an alloy of iron and titanium that was able to withstand the frenetic pace of the machine. More recently, we began using carbon fiber, agglomerated by a resin that solidifies under polarized light, for the cylinder wall. They have improved the performance of the motor, the balancing techniques, and the control electronics. In recent years, Brazilian private industry has made a decisive contribution—about 150 companies have been involved so far, furnishing the widest possible variety of equipment and components, from vacuum pumps to computers (see box below). Two years later, nine machines were ready to work together in the first "cascade," the system by which the individual machines are interconnected. "Each one of the ultracentrifuges bore the name of a pretty woman," laughs Othon today. "The one named Bruna Lombardi, for example, was very popular."

For interaction on such a scale it was decided that the enrichment plant would be set up in Ipero, near Sorocaba, in the vortex of the industrial whirlpool of the Southeast. The 300 ha tract at the Aramar site will also be the site on which a 50-megawatt reactor will be built. The facility is not very tall, but requires special, highly reinforced armoring. The first steel containment enclosure will have a diameter of 8 meters. It would be surrounded by a moat of water, held back by the second shield, which will be 14 meters high. A 20-meter tall concrete building—equivalent to 7 floors—will serve as the final envelope around the reactor.

The reactor is already past the drawing board stage. It has cost $40 million so far, and several components are on order from Brazilian industry. It is hoped that it will be operating by 1992, ready for testing in the submarine that is yet to be built—a strategic objective for the Brazilian Government. "There is no power without a strong Navy," argues Henrique Saboya, minister of that portfolio, as he pointed out that 96 percent of Brazil's foreign trade moves by sea. A nuclear submarine—which, as the military keep telling us, is not to be confused with a unit that necessarily transports atomic war materiel—is able to stay underwater for more than 6 months and is faster and quieter. "Such a ship would put the Navy on a different plane," suggests Saboya.

The desire to modernize Brazil's fleet became more acute after the early 1970's when there was the concern among members of the Naval Staff about the dependency on American armaments. "Our ships were American and so was all the technical assistance and logistical support," said Fleet Adm Mario Cesar Flores, director general of the Navy and head of the submarine project. The decision has been made that progress may be slow, but the effort will be Brazilian. Assembly of frigates of British design and manufacture has begun. Under an agreement signed with Germany, Brazil has decided to manufacture five of these warships, to be incorporated into the Brazilian fleet during the next several years. The first, to be christened the Tupi, is almost ready at German shipyards and will arrive in Brazil in September. Three others will be built in Brazil, but still with German collaboration. Price of each unit: $150 million. The fifth ship—completely Brazilian and to be built at the shipyards of the Navy Arsenal in Rio—has been estimated at $200 million. All of them use conventional fuel, but the fifth will be used to test the nuclear reactor. "Our industry is being called upon to raise itself to ever higher technical levels," says Vice Adm Elcio de Sa Freitas, the Navy's director of naval engineering.

It would have been impossible for such an ambitious plan as regards the future of an industry, involving so many stages, to be received with unanimous enthusiasm. Last Friday, physicists from Brazil and Argentina reiterated their joint stance against nuclear programs that have a military purpose. "Nuclear programs must always be under strict civilian control and mechanisms must be created to effectively insure that only peaceful ends will be pursued," argues a joint note from the Brazilian and Argentine associations of physicists which was distributed during the visit of presidents Sarney and Alfonsin to the facilities at Aramar. Alfonsin's trip to Ipero was made in return for the visit of his Brazilian counterpart to the uranium isotopic enrichment plant at Pilcaneyou, in Argentina. Thus another link was added to the bilateral cooperation between the two countries. "The two facilities bear unmistakable witness to the ability of our two peoples to develop the latest technologies by their own means and for peaceful purposes," urges the joint statement distributed on that occasion.

"The cooperation agreement will be worthwhile politically because Brazilians and Argentines have been atavistically preparing for war for more than 200 years, making plans to attack each other," said veteran nuclear chemist Alcidio Abrao, expressing his great satisfaction. At 62, Abrao is the director of nuclear materials for IPEN. "The two-way mistrust must come to an end." Last month, a committee of Argentine technicians came to IPEN and suggested some areas for cooperation. They are interested in the aborted Brazilian experiment with the Torio—a group in Belo Horizonte had been working

in that area but has since disbanded. Their attention was also attracted by IPEN's method of obtaining hexafluoride, the purification stage prior to enrichment, carried out under the leadership of the chemist Alcidio. Another area for potential collaboration is the production of zircaloy—the alloy used for cladding the fuel rods in the reactors. Argentina already makes those rods, but buys the alloy in Europe. Brazil imports those containers, but is already making zircaloy in a pilot plant, something which Argentina does not yet know how to do.

There is heroism behind performances such as these. Around 1979, the French company Pechiney—which, in association with Nuclebras, makes yellow cake at Pocos de Caldas—offered to transfer to the Brazilians this basic step in the control of the technology. It would charge $60 million, payable over a 4-year period, for a process under which 540 tons of ore could be converted each year. A group of IPEN experts then entered into contact with CNEN to offer their services. Led by Romulo Pieroni, a medical doctor and then director of IPEN, they said they had the ability to master the process. It was still 1979 when President Ernesto Geisel intervened directly in the program. Although he expressed little faith in the IPEN scientists, he backed the beginning of what today has been officially baptized the Autonomous Nuclear Technology Program, PATN.

While research to master the fuel cycle was underway, the CNEN and IPEN technical staff received several offers from companies—both those inside and outside the Brazil-Germany agreement—of advisory or consulting work or even employment. Even instances of espionage were noted. And there are questions too—such as that hole at Serra do Cachimbo, said to have been dug to shelter tests of nuclear devices—or the secret bank accounts used to fund the program and still the source of a lot of controversy.

Bomb Under Discussion

Certainly one controversy that is unlikely to end soon is the question of whether or not Brazil included the future manufacture of an atomic bomb in its secret program. "The Brazilian Government has taken the political decision not to make nuclear weapons," Minister Saboya assures us. "We have the technological capability to achieve any level of enrichment, but we have opted to stop at 20 percent," says Adm Pinheiro da Silva. A 3-percent enrichment is sufficient for electrical power generating in plants such as those at Angra. Enriched to less than 20 percent, uranium can be used in research reactors. And in the 20 percent range, one can power a nuclear submarine. Making an atomic bomb, however, requires no less than 90 percent enrichment—which would necessitate a plant with more than 4,000 centrifuges, 100 times more than the capacity installed at Aramar.

"It would be stupid to enrich uranium to nearly 100 percent in order to build the Brazilian bomb," the physicist Cerqueira Leite says emphatically. The shortcut route is the one India took—the plutonium bomb, made from one of the byproducts of the operation of the power reactors such as Angra-I. Even then, the problem is complicated because of the need to evade the rigorous controls exercised by the International Atomic Energy Agency. If we believe the repeated statements by our officials, Brazil has not chosen the Indian path either. And in all countries which attach importance to their nuclear industry this question has always been relevant. What is most important is that decisions of this type must necessarily pass under the scrutiny of the legislative branch.

[Box, p 48]

Profile of an Eclectic

Coining clever phrases is one of the manias of the admiral who managed the installation of the Aramar Experimental Center. Take, for example, his comparison of the fuel cycle with the culinary process involved in making "feijoada." On another occasion, in order to draw a distinction between his duties as a military officer and those as a researcher, Adm Pinheiro da Silva came out with, "Electrons don't use uniforms, nor does the nucleus of an atom wear a cap and gown." Concerning the start of the project: "We started with our feet on the ground," he said. "I mean that in two ways—we were realistic, and we didn't even have money for shoes." An avid tennis player and swimmer, the admiral lives in Sao Paulo—since 1982, in the posh neighborhood of Jardins. He married very young and his children have either graduated or are still in the university. The force of his arguments carried a lot of weight when Project Cyclone was in its embryonic stage. "The Navy entered the autonomous program after having been convinced by Adm Othon to do so," a CNEN source reveals. When he came to IPEN to manage the parallel project, his presence obviously irritated many researchers who saw him as a sort of military interventor. Pinheiro da Silva was good at handling sticky situations. "He was always very refined in his relations with his colleagues; for one thing, he didn't wear his uniform at IPEN," Claudio Rodrigues recalls.

Pinheiro da Silva's choice of the reactor has historical roots: "Not to use nuclear energy in submarines would be as if we had disregarded steam and kept only our sailing vessels." A nationalist, he defends the computer technology market reserve. He preaches that "no society is viable without its own technology." That is why he gives so much emphasis to the scientific and technological training programs: "There is nothing stronger than our ability to generate ideas," says Pinheiro da Silva, who reads Jorge Amado and is a fan of books on political science. In his free time he also reads biographies, such as the ones on Mao Tse Tung and Francisco Franco, which he bought at the bookstores during Holy Week. He

also likes the movies. The last film he saw was "No Way Out," a fast-paced story of life behind the scenes in the Pentagon which may have reminded him of the nuclear race he is involved in.

[Box, pp 50-51]

The Challenge for Technology

These are the four phases in Brazil's plans to build a nuclear powered submarine:

1. An ultracentrifuge is used to separate the uranium isotopes. Uranium in the form of a gas is introduced into a heavy duty cylinder that rotates at a high speed. Owing to the action of centrifugal force, the heavier isotope is dashed against the wall of the cylinder. The lighter portion of the uranium, the one that can be used in reactors, stays in the center. Thus the separated gases can be extracted by collectors in the lower part of the centrifuge. This is enrichment, as developed at IPEN in Sao Paulo. Each separate ultracentrifuge can enrich only a small quantity; therefore, it becomes necessary to interconnect them through a method known as "cascade" [illustration].

2. In order to increase the quantity of enriched uranium, the horizontal rows of centrifuges are extended. To enrich the uranium to a higher percentage, the connections in the vertical direction are increased. The same method is also used at Ipero. The actual arrangement of the "cascade" is always kept secret and very few photos like the one of the Oak Ridge laboratory in the United States [illustration] are known to exist.

3. By 1992, the nuclear reactor intended to power the submarine (the smaller yellow cylinder in the sketches [illustration]) should be ready. The largest containment wall will be 14 meters high and will surround a pool of water. For greater safety, there are two more containment walls.

4. The reactor, as a propelling force, will occupy a very small part of the submarine complex (see enlarged detail [illustration]). The reactor will be built at Aramar and adapted to the submarine.

[Box, pp 52-53]

An Industrial Jigsaw Puzzle

Project Cyclone designed an operation worthy of a spy story plot in order to set in place one of the most crucial pillars supporting its success—getting about 150 domestic companies to make components for the plant. "We were not permitted to know what the entire plant looked like; each of us we given specifications only on very well circumscribed portions," said Minas native Marcio Leonardo of Malc-Automacao e Informatica, of Belo Horizonte last week. The contacts made by the Office of Special Projects Coordination, Copesp, headed by Adm Pinheiro da Silva, with Jamaica Industria Eletronica of Sao Paulo were conducted in a similar manner. "We said that we needed valves of a specific diameter in millimeters, and the ability to maintain a nearly absolute vacuum," said Piramo Ferri, 40, general manager of Jamaica. Every contract with the companies contains a confidentiality clause. This is why, for example, a certain Eberle, of Caxias do Sul, refused last week to indicate which components Copesp had ordered from him.

Occasional Meetings

"From my experience, the sketch I saw looks something like a nuclear submarine, speculates Fernandes Lucena, a mechanical engineer, 32 years with the company. According to him, Navy officers met with him periodically while each component was being manufactured. "Former Minister da Fonseca himself sometimes picked up the telephone to talk with me directly about the details of a given part," Lucena said.

The threat of industrial espionage apart, the Navy's Copesp demonstrated an encouraging ability to enlist the aid of industry. An electronics firm that makes capacitors for automobiles and telecommunications, or thermal fuses (such as the pop-out thermometer in Sadia turkeys), Jamaica become involved in an entirely new field. "We had already made plenty of valves before, but never so well sealed as to maintain an almost complete vacuum," explained Piramo Jr. The part was needed to ensure a vacuum between the rotating cylinder of the centrifuges and its external protective casing—a feature that would reduce friction. Copesp ordered 200 of those valves, with diameters ranging from 35 to 135 mm. The one who designed the high vacuum valve, using a photograph of a foreign instrument, was Piramo Jr.'s father, a lathe operator and owner of Jamaica.

Well established in the sector of electronic equipment for industrial automation, Malc sold Copesp a system to oversee industrial process control at Aramar. It has three panels and is linked to a 8086 microprocessor that uses Malc's own software, Supercon-D.

Saving Foreign Exchange

"At any moment we can make a diagnosis of the process and the equipment, check the frequency of defects, issue production reports and draw graphs of trends," says director Marcio Leonardo. Ordered in 1986, the equipment would cost $300,000 at current prices. Researchers associated with the university also took part. The Technological Center Foundation, Cetec—also of Minas Gerais—succeeded in making production of elementary phosphorous feasible. That substance is needed to make special solvents and the knowledge was mastered on a pilot scale by the Federal University of Rio de Janeiro and USP. CNEN calculates that something in the range of $10 million a year will be saved by eliminating imports of elementary phosphorous; this is a striking example of the industrial benefit achieved.

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COLOMBIA

Nazare on Ipero Critical Facility, Fuel Uses

51002022c Sao Paulo O ESTADO DE SAO PAULO in Portuguese 7 Apr 88 p 31

[Text] Brazil is not merely enriching uranium at the Aramar Experimental Center in Ipero, Sao Paulo, as the National Nuclear Energy Commission (CNEN) announced last year. In Sao Paulo yesterday, the president of that body, Rex Nazare, confirmed that a project involving a compact reactor of the PWR type has been under way since 1982. He said that the Navy has invested about $50 million, "in accordance with the effort to contain expenditures," and the critical unit is now almost ready. "This reactor will be used both for propulsion and the generation of nuclear energy. This technology, therefore, represents a complex of interests."

Nazare made no secret of the fact that the Navy is especially interested in this project, but he declined to go into detail for reasons of security. Moreover, secrecy prevailed during the press conference he held yesterday to explain how the Aramar Experimental Center is functioning. The first phase of the pilot plant for uranium isotope enrichment will be inaugurated by President Sarney, accompanied by Argentine President Raul Alfonsin, tomorrow. "The presence of President Alfonsin will be an expression of reciprocal confidence to his country, since during their official visit, he made a point of showing our government leaders the technological stage Argentina has reached in this field."

According to the president of the CNEN, the fuel which will be produced in Ipero will enable the three reactors in the country, located in Belo Horizonte, Rio de Janeiro and Sao Paulo, to operate full time. "For strategic reasons, the last time Brazil was able to import fuel was in 1979. From that time to this, we have been using these laboratory reactors for only 5 hours a day, 5 days a week."

Rex Nazare stressed that Brazil has joined the group of eight other nations which have mastered enrichment technology, while only three have both the technology and large reserves of uranium. They are the United States, the Soviet Union and Brazil. For this reason, he believes in Brazilian development in this field. "The world market for enriched uranium comes to about $11 billion per year. No one, however, wants to share this market, nor to release photographs, specifications or the norms used in building their reactors, either."

Among the things it has been possible to report is the process chosen by the country for uranium processing. The methods with industrially demonstrated efficiency include gas diffusion and ultracentrifuging (at Angra I, II and III, the technology involves the jet centrifuge, which is of dubious efficiency, as Rex Nazare himself admits). Because of factors having to do with the consumption of electrical energy, Brazil chose ultracentrifuging, and since 1980 has spent about $81 million, 5 percent of which went for the import of equipment.

5157

PALESTINIAN AFFAIRS

Palestinian Expert Discusses Nuclear Strategy

51004503a Kuwait AL-WATAN 28 Mar 88 p 14

[Interview with Dr Nafi' al-Husayn, Palestine Liberation Organization Strategic Affairs Expert, by Hamdi Salim in Cairo]

[Text] AL-WATAN met Dr Nafi' al-Husayn during his recent visit to Cairo to attend the international symposium of the Egyptian committee of peace and disarmament, which was held under the title "Making the Middle East and the Mediterranean Basin Areas Free of Nuclear Weapons."

A Political and Psychological Deterrent

At the beginning, Dr Nafi' al-Hasan stipulated that the weapon of nuclear deterrence is not like a traditional weapon because it cannot be used at any moment. It is a weapon of physical military deterrence and involves political and psychological deterrence. The strategy of nuclear deterrence in Israel is twofold: firstly, it is a strategic deterrence which includes the possession of the hydrogen bomb and systems for launching defensive missiles and a protective umbrella; secondly, it is a tactical nuclear deterrence, which includes the possession of a mini-bomb with intermediate and short range launching missiles.

[Question] Does Israel now have the hydrogen bomb?

[Answer] It has not managed to produce it yet, but it is in the research stage. It has resorted to the most suitable option for the field, geographic and demographic conditions of its struggle in the Middle East. This option is called the tactical nuclear option, and it aims to struggle with the Arab armies and psychologically deter the Arabs to prevent them from launching an attack by land on Israel.

[Question] What exactly is the quasi-nuclear option?

[Answer] It is the production of mini-bombs of various sizes that can later be directed at command, supply and provision centers, major economic industrial organizations, and some major civilian centers, which means paralyzing the ability of the army on the front to continue fighting. It also includes the use of cluster bombs against armies taking part in the fighting.

These bombs are a new type and in Israel they range from 150 to 200 in number. To manufacture them, Israel uses highly enriched uranium which it obtains from the United States and South Africa and plutonium from France. Israel produces from five to 10 of this type per year. A single bomb can kill from 20,000 to 30,000 persons within a radius of 5 to 10 km without any radiation or nuclear fallout descending on the area. Here the danger of the hydrogen bomb to Israel itself is apparent, since it will not be spared the danger of radiation and pollution.

[Question] It is well known that a nuclear bomb, however small it might be, at the very least requires the performance of test explosions to measure the force of the explosion. How has Israel solved this problem?

[Answer] By means of modern computer systems it has imported from America. It can measure the force of the explosion in a mini-bomb without having to carry out a nuclear explosion. It has also imported American explosive devices of the Kryton type which will carry out this operation subsequently, and it is continuing its programs to develop systems for launching medium-range missiles and defensive missiles, develop the air force and provide a front-line deterrent force adequate to deter any Arab land offensive.

The Final Option

[Question] However, Israel has carried out three big nuclear explosions around the continent of Antarctica in cooperation with America, France, Norway, and South Africa, which have involved three detonations. The first was in 1979 and the other two were in 1986. Does this mean that Israel, in spite of all the dangers, is on its way to producing a hydrogen bomb far from the entire area which it will be able to drop by air onto places in the Arab nation which are remote from Israel?

[Answer] Israel will not be spared in this event either; rather, resorting to production of the hydrogen bomb represents a great economic burden for Israel and puts international pressure on it. Moreover it does not need it now or in the future, because of the current phase of the Arab-Israeli struggle, where there is no war and no peace and Israel does not feel that there is a serious Arab threat to its existence, and in the future it will not be able to, because the theory of conflict in the nuclear age is founded on an assessment by the country concerned that if anyone tries to direct a first strike against it it will answer it with a mortal strike. This model theory in respect to nuclear conflict does not conform to Israel's situation in the Arab region and Israel absolutely cannot wait to direct a second blow, because a single bomb will totally annihilate it. Therefore, contrary to the classic theory of conflict in the nuclear age, it is trying to mobilize all its forces to preserve the ability to direct a first strike; however, directing a first strike means that it will need at least 50 hydrogen bombs to strike at the Arab world. Here Israel's historic dilemma stands out. It cannot direct a first strike without being affected by nuclear radiation; if it receives a second strike from the Arabs, that will put an end to its existence. That is, the nuclear bomb is the final option or specifically the

ultimate characterization of its historic dilemma. Here it is also clear that the nuclear weapon is not a solution or a guarantee of Israel's security and protection of the essence of its existence.

What Is the Purpose?

[Question] Certainly Israel realizes this fact. What is the purpose of manufacturing such a quantity of nuclear mini-bombs and its feverish effort to develop its nuclear program to make the hydrogen bomb?

[Answer] The purpose of Israel's possession of this weapon is to maintain its freedom in fighting the Arabs with traditional weapons. In order for better, more rapid successes to be achieved, the Arabs must also have a nuclear deterrent, so that nuclear weapons in the whole area will be converted into an impotent weapon, depriving the Israeli nuclear deterrent of its credibility.

Because nuclear weapons are weapons of comprehensive destruction, they cannot and must not be permitted to remain the hostage of the will of a person or a group of persons, and the political leadership must be able to control the use of this destructive weapon at moments of maximum danger. There are indeed restrictions on the Arab and Israeli parties which limit the freedom of use of it by one of the parties against the other. The Arabs will take into consideration that using it against Israel will mean eliminating no less than 3 million Palestinians living on the occupied territories and some thousands of Arab inhabitants in the countries neighboring them, as well as the loss of the Islamic and Christian holy places. For the Israelis, its use entails a mortal threat to its existence, as we have stated.

The Doctrine of Overpopulation

[Question] How do the Arab peoples deal with this fact? How do they face it, and what is your plan in the Palestine Liberation Organization for confronting this danger?

[Answer] First of all, we assert that we are not proponents of nuclear arms proliferation, because nuclear arms have spread for purposes of destruction and annihilation. In confronting destructive nuclear weapons, we leave it up to the Arab brothers to find the solution to the Israeli nuclear deterrent. However, what we ourselves can do, and ask of the Arab peoples, of course, is to devise a doctrine of overpopulation; we will respond to them by the human element. We are becoming overpopulated on every bit of land so that we can turn the nuclear weapon into one that is paralyzed and incapable of deterrence, by operating the Palestinian and Arab machine of reproduction and population increase.

It is also necessary to formulate a new population policy in the Arab nation, especially in the countries surrounding Israel, so that the population will accumulate in nearby new cities and not cities that are uninhabited. We must spread horizontally and if Israel today needs 50 hydrogen bombs to strike at the Arab world, in the context of the spread of population it will need 100 bombs, assuming that the intent to use this deterrent nuclear weapon exists on Israel's part.

The Announcement and the Denial

[Question] What is your view on the policy of nuclear obscurity Israel is pursuing?

[Answer] We do not need a media declaration from Israel to prove whether it has it or not. The matter of announcements is a political one, not a technical one. I believe that the reasons which lie behind the refusal of the ruling elite in Israel to declare its nuclear activity inside and outside the occupied territories are to keep public opinion from participating in any discussion on nuclear arms in a manner which will lead to a general discussion in institutions and bodies, which might lead to a demand for the establishment of control or the imposition of international or local surveillance over their use and a curb on the ruling elite's monopoly of the adoption of such a grave decision. In addition, if a Zionist knows that he is sleeping on a nuclear arsenal, he will be stricken with panic and will realize that Israel's security will not be achieved by the causes of destruction and has not been realized by traditional arms, by a peace agreement or by Golda Meir's walking about in Khan al-Khalili.

He will realize that nuclear arms entail suicide and annihilation, which will provide an incentive to look for another safe place in which he can live besides Israel. There also are possibilities that the discussion will shift from the local community to the international one, prompting popular anti-nuclear armament movements in the world to put pressure on Israel, to rid it of the wherewithal for the destruction for the whole region, as is happening now in Europe. The peoples of Western Europe close to our shores and our region have no interest in letting Israel be a source of nuclear conflict and terror which could develop into a worldwide struggle ultimately leading to catastrophe on all levels in all areas. After all these facts, what are we waiting for? Peace with Israel? Between whom and whom? The Arabs as rulers and regimes have no recourse but to possess nuclear bombs in order to paralyze Israel's nuclear capability, and the Arab peoples have no recourse but to carry out Dr Nafi' al-Hasan's doctrine of overpopulation and the creation of concentrated population areas adjacent to Israel inside and outside the occupied territories so that it will thereby be impossible to drop any nuclear weapons, in addition to creating a great security threat and severe resistance to Israel in these regions, with the serious effort to put Israeli nuclear activity under international supervision while waiting for acquisition of the nuclear bomb which in spite of its great economic cost will solve the entire problem in any event.

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BANGLADESH

Energy Minister Tells Uses of Nuclear Technology

51500156 Dhaka THE NEW NATION in English 15 Mar 88 pp 1, 8

[Article: "Economic Feasibility Report on Rooppur Plant Soon: Anwar Hossain"]

[Text] Energy and Mineral Resources Minister Mr Anwar Hossain has said that the present Government was determined to set up nuclear power plant in the country and added economic feasibility of the proposed Rooppur atomic power plant was being studied.

The feasibility report about the Rooppur plant is expected to be available shortly, he said while inaugurating the first national seminar on industrial radiation processing held at the auditorium of Bangladesh Chemical Industries Corporation (BCIC) in Dhaka yesterday.

The inaugural session of the seminar was presided over by Dr. Anwar Hossain, Chairman of Bangladesh Atomic Energy Commission (BAEC) and addressed by Dr M.A. Mannan, Chairman of seminar committee Dr. V. Markovic, representative of International atomic Energy Agency (IAEA) Mr. A.K.M. Mosharraf Hossain, Chairman of BCIC and Dr FR Al-Siddique, Member-Secretary of organising committee.

Jointly sponsored by BAEC and BCIC with cooperation from Regional Cooperative Agreement (RCA), IAEA and UNDP, the four-day seminar will discuss both technological and economic aspects of application of radiation in industrial process and production.

About 100 scientists, technologists and management executives from 29 private and public sector industries and autonomous research organisations are participating in the seminar. Experts from Japan and India are also taking part in it as resource persons.

The Energy Minister said that a huge amount of gas was being utilised for generation of electricity in the country. In this connection he said that the pressure on gas could be reduced by using atomic energy instead of gas for power generation.

Mr Hossain referred to the role of our nuclear scientists and technologists concerning peaceful application of atomic energy and called for continued efforts for use of nuclear technology in national development. He said it was possible to contribute our mite to development activities through identification, exploration and proper utilisation of our resources.

The Minister referred to allegations that there was no communication between the industrialists and the scientists and technologists in the country and that exchange of ideas and opinions and cooperation between them were absent. Technology was growing in the country either through foreign aid or through indegenous processes at Jinjira, Dholaikhal and Narinda while the scientists and technologists were living far away, the allegations said, Mr Hossain pointed out.

He expressed the hope that the cooperation between the scientists and technologists and local entrepreneurs would be strengthened through this seminar leading to the growth of more advance technology in the country. He assured that the government would seriously consider the recommendations of the seminar which would be helpful to the entrepreneurs in future.

Dr Anwar Hossain, Chairman of BAEC, said industrial application of radiation technology would improve the quality of our industrial products and make those competitive in the international market. He said application of radiation in industrial processing was also cheaper and energy efficient.

He said BAEC had ventured to utilise the results of its research in setting up a commercial gamma irradiator in Chittagong in order to pave the way for commercial application of radiation technology in industry. He said the IAEA was supplying the source from the Soviet Union and the project was expected to be completed by early next year.

/12223

INDIA

Talks With USSR on Nuclear Power Plants End

BK2904115488 Hong Kong AFP in English 1149 GMT 29 Apr 88

[Text] New Delhi, April 29 (AFP)—An Indo-Soviet technical and scientific cooperation meeting ended here Friday amid reports that the two sides had finalized an agreement for Moscow to build two nuclear power plants in India.

Parliament was told Wednesday that the 3.6 billion dollar deal for two 1,000 megawatt light water plants was on the verge of signing.

In other decisions at the mid-year meeting, the PRESS TRUST OF INDIA (PTI) reported that Moscow was also willing to assist India in the search for ground water and other irrigation sources, while India said it was willing to build 70 new hotels in the Soviet Union by the year 2000.

The Soviet side, headed by Deputy Premier Vladimir Kamentsev, had also submitted proposals to supply the IL-96-300, TU-204 and IL-14 aircraft to India after 1990, PTI said.

The commission is scheduled to meet again in New Delhi in November or December after the two chairmen confer in Moscow in August.

Government Plans 10 More Atomic Reactors

BK0705160588 Delhi Domestic Service in English 1530 GMT 7 May 88

[Text] The government is planning to set up 10 more atomic reactors to increase output of nuclear power. The chairman of the Atomic Energy Commission, Dr M.R. Srinivasan, said this at a seminar on nuclear technology in New Delhi today. He said the first 235-megawatt unit of Narora atomic power plant will start operating this year. The second will be ready in 2 years. The Kakhrapar plant near Surat in Gujarat will become operational in 1991.

External Affairs Official: No Change in Nuclear Policy

51500153 Bombay THE TIMES OF INDIA in English 6 Mar 88 p 1

[Text] New Delhi, March 5—India today reiterated its opposition to any attempt to equate India's indigenously-developed nuclear programme with the weapons-oriented programmes under military control, built on materials and designs acquired clandestinely from the West in clear violation of their laws and regulations.

A spokesman of the external affairs ministry said there would be no change in India's nuclear policies, including the principled stand on the nuclear non-proliferation treaty and international safeguards. "Our policy is guided by global considerations and not by so-called regional or bilateral considerations", he said.

The spokesman was asked to comment on a Washington report in this daily, suggesting that India may be willing to change its policy on nuclear safeguards as was the impression gathered by a senior staff member of the senate foreign relations committee, Mr Peter Galbraith.

The spokesman said that Mr Galbraith had evidently reached some unwarranted inferences about India's nuclear policies after his courtesy call on the Prime Minister, Mr Rajiv Gandhi, and meetings with officials.

According to the report, Mr Galbraith had devised a formula under which both India and Pakistan could accept safeguards for a number of nuclear facilities. He got the impression in India and in Pakistan that such a formula might provide the basis for a regional nuclear accord between the two countries.

/06662

DAE Establishes Panel for Isotopes Program

Bombay THE TIMES OF INDIA in English 6 Mar 88 p 5

[Text] Bombay, 5 Mar—The Department of Atomic Energy has set up a board for the isotopes programme.

The Board of Radiation and Isotope Technology (BRIT), headed by the chairman of the Atomic Energy Commission, Dr M.R. Srinivasan, became effective on 1 March.

Dr P.K. Iyengar, director, Bhabha Atomic Research Centre, is a member of the board and other eminent scientists from industry and public health will be inducted as members. Mr R.G. Deshpande, director of the isotope group at BARC, has been appointed the chief executive of BRIT.

The radiation technology and isotope applications programme has been identified by the government as a "technology mission" of the DAE.

The current programme of the isotope group of BARC includes production of isotopes from nuclear reactors, radiochemicals, agrochemicals, self-luminous compounds and over 200 other compounds labelled with carbon-14 and tiritum. It also produces iridium-192 and cobalt-60 as radiation sources for application in industrial radiography and cancer therapy.

India is one of the seven countries in the world, self-reliant in this field.

/9604

Group Established To Deal With Nuclear Accidents

BK1205081088 Delhi Domestic Service in English 0730 GMT 12 May 88

[Text] A crisis management group has been set up at the headquarters of the Department of Atomic Energy in Bombay to deal with nuclear accidents. The group will deal with all emergency situations that may arise due to accidents at atomic power plants or any other nuclear installations.

Set up on the recommendations of the Cabinet Secretariat, the group will be responsible for ensuring that each of the nuclear installations is adequately equipped to deal with radiation hazards.

Paper Gives Details on Heavy Water Plant Closing

51500155 Madras THE HINDU in English 21 Mar 88 p 9

[Text] Baroda, March 20—The heavy water plant of the Atomic Energy Department near here which was shut down on Friday, following a blast which resulted in a fire

and leakage of ammonia gas, is likely to remain closed for about two months, Mr. S. M. Sundaram, Chief Executive of Heavy Water Projects told PTI today.

The team of top officials of the Department of Atomic Energy inquiring into the cause of blast, fire and ammonia leak, has not yet drawn any conclusions.

"It is difficult to come to any conclusion at this stage", Mr. Sundaram said, adding that "I do not suspect any mischief by any workers behind this mishap in the plant".

Mr. Sundaram said he was satisfied with the steps taken by the local management in controlling the fire and subsequent safety measures adopted. The fire had occurred in the region between two synthesis gas purifiers. Emergency measures to isolate the plant from the GSFC had been effected as per the procedures. Compartmentalising of the high pressure section and the low pressure sections had taken place as intended automatically, he said.

Fire Extinguished

The fire was contained to the region of the gas purifiers and was totally extinguished within an hour's time. However, ammonia leak within the isolated sections where the fire took place continued for some time. A water-envelope was created in the region and the spread of ammonia was confirmed and limited to the effected area only, he said.

However, water sprays were being maintained as a precautionary measure for a longer period and there was no casualty or injury in the incident. The fire and ammonia leakage also did not affect the people living nearby, he said.—PTI

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PAKISTAN

India, Israel Claimed Considering Attack

46000124c Islamabad THE MUSLIM in English 28 Mar 88 p 1

[Text] March 27: India and Israel were reported to have discussed the possibility of making a strike at Pakistan's nuclear facility in Kahuta, outside Islamabad, the BBC reported quoting a London newspaper. The broadcast quoted the report as saying that both India and Israel were worried about Pakistan's nuclear capability. Both countries, according to the London newspaper, realised that Pakistan had the know-how and skill to produce nuclear weapons. India was afraid that Pakistan may ultimately use its nuclear weapons against India while Israel was concerned that the nuclear technology may spread to Arab countries or Pakistan may supply these countries with nuclear weapons.

In its 24 hours Programme, the BBC broadcast an interview with the LONDON OBSERVER correspondent in Jerusalem who had previously served s his paper's representative in New Delhi. The newsman in his report said he would not be surprised if contact had been established between India and Israel on the subject.

In response to a question, he said, there is an Israeli Counsel-General in Bombay who could have been the intermediary or possibly the two countries might have discussed the matter outside India and Israel as they had no diplomatic relations with each other.

The interview quoted Israeli officials as believing that the only drawback Pakistan had in the production of nuclear weapon was its financial limitations. But, the newsman said, this might have been made up by Libya and Saudi Arabia.

The BBC said relations between Pakistan and India have been deteriorating increasingly over the past two years and India might make a preemptive strike against the Kahuta facility.

The OBSERVER correspondent expressed the opinion that despite strained relations between New Delhi and Islamabad, India would not like to get involved directly in any assault on the Kahuta plant. New Delhi would prefer Israel did the dirty work, the BBC said.

The correspondent quoted Indian viewpoint outside the government as being heavily in favour of such a strike, the broadcast added.

APP adds: BBC in its "South-Asia Survey Programme" said that there have been reports from the United States that India had assembled a number of sophisticated atomic bombs.

It said the source of these reports is said to be former National Security Council officials and Congressional staff workers.

BBC said, in this connection its correspondent phoned Washington and spoke to Congressman Charles Wilson, a member of the appropriations subcommittee on defence, and asked him if he believed India had the bomb.

In reply to the question the Congressman said, "Well, I certainly do. India has an extensive plutonium separation process that produces weapons grade plutonium and I know no reason why they would have this separation process if they do not want separating plutonium.

Replying to another question how many of these weapons he believed India had and of what sort they were. He said he would guess a couple of dozens and probably delivered by airplane but India had a fairly extensive

research and development programme of several different missiles which would deliver the plutonium warheads and also they had recently purchased the Soviet missile launching submarines.

The Congressman said the United States intelligence community as well s the State Department was absolutely positive that India was separating plutonium.

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Opposition Leader Urges Nuclear Development
51004725b Lahore THE PAKISTAN TIMES (Supplement) in English 21 Apr 88 p IV

[Excerpt] Islamabad, 20 Apr—The leader of Opposition in Parliament, Syed Fakhr Imam, has said the nuclear programme is the most important issue for Pakistan and it is in Pakistan's interest to continue this nuclear programme.

In an interview with the Voice of America, Syed Fakhr Imam said high technology, transfer of technology and nuclear energy all have basic share in the energy problem of Pakistan. Along with coal based industry hydroelectric and thermal industries as well as the nuclear industry is also part of modern technology. Then why should Pakistan lag behind. He said "We see that India exploded nuclear bomb in 1974, and required nuclear submarines and technology of inter ballistic missiles having range of 1200 miles. We also see that America is providing super computers to India while Soviet Union is also providing it with technology along with Western Europe. Then why Pakistan should remain behind any country. It is therefore, in our national interest to continue with our nuclear technology."

In reply to a question, syed Fakhr Imam said the people in Pakistan are waiting to see whether the present political system running for the last three years will continue and whether the present Government will remain in power or other Government chosen by the Pakistani people through votes comes to power. No political national consensus has emerged properly in Pakistan as it should have been, he said. He further said if next elections are held under a national consensus, headway could be made to a great extent in solving political and socio-economic issues of Pakistan.

/9274

Poor Security Alleged at Karachi Nuclear Plant
BK300654 Delhi Domestic Service in English 0630 30 Apr 88

[Text] The Karachi nuclear power plant in Pakistan is reported to be one of the least safeguarded plants in the world, which could trigger off a nuclear holocaust. PTI, quoting a Pakistani newspaper, DAILY NEWS, says lack of security in and around the plant coupled with the easy availability of explosives has alarmed Pakistani security experts. One security expert told the paper that if a nuclear disaster occurs there, it can be much worse than the Chernobyl accident in the Soviet Union.

Nuclear Power Plant Training Simulator Fabricated
51004725a Karachi DAWN in English 18 Apr 88 p 14

[Text] Karachi, 17 Apr—A nuclear power plant training simulator has been fabricated by the instrumentation and control division of the Chashma Nuclear Power Project (CHASNUPP) in association with the electronics and General Services Divisions of Pakistan Institute of Nuclear Science and Technology (PINSTECH) it is learnt.

The simulator consists of an operator console, three colour television sets for plant variable displays, a terminal to serve as the instructor station, and a computer to perform simulations in real time.

The simulator presents a simplified model of the reactor core, primary coolant system, steam, steamgenerators feedwater system and turbine.

It is capable of manoeuvering operations from hot shutdown to full power operations and plant startups. It can simulate up to 11 system malfunctions and incorporates the standard features of a simulator such as freeze simulation, fast simulation, back track and snapshots.

The simulator has been handed over to the centre for nuclear studies.

Meanwhile, PINSTECH has successfully fabricated ceramics material which demonstrates superconductivity at 88 K which a few degrees above the temperature of liquid nitrogen.

The Pakistan Atomic Energy Commission (PAEC) has started this work recently and has been able to develop yttrium-based metal oxide ceramics in its nuclear material laboratories.

The superconducting behaviours of this material was demonstrated in September last and has since then been repeatedly verified.

As is already known, the discovery in superconducing material at relatively high temperature was announced in the later part of 1986. A large number of laboratories in advanced countries have been carrying out intensive research to make superconducting materialise at higher and higher temperature. The 1987 Nobel Prize in Physics has been awarded to two physicists at the IBM Zurich for pioneering work in this field.

Achieve of superconductivity at high temperatures has a large number of potential applications in different fields of industry, transportation, medicine, ultra fast computers and scientific research.

One near term application of this scientific discovery is construction of strong magnets which are used in scientific research.

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Paper Views India's 'Ambitious' Nuclear Program
BK1405091588 Karachi DAWN in English
9 May 88 p 7

[Editorial: "Heavy Water"]

[Text] What an Oslo newspaper reported has finally been officially confirmed by Norway—that over 15 tons of heavy water has been "missing" since 1983. An official Foreign Ministry spokesman, however, did not accuse any particular country of having stolen the precious fluid. But an expert at the Natural Resources Defence Council in Washington said that India was "in the market" for heavy water and that "circumstantial evidence" suggested that the missing heavy water had reached India. Oslo paper VERDENS GANG also gave details of the cloak-and-dagger operation in what the Norwegian Foreign Ministry called "an international conspiracy" and reported how, thanks to a German with a Nazi past, the 15 tons of heavy water were flown on a Liberian-registered West African Airlines plane and how it ultimately reached its destination in India via Basel and Dubayy.

The illegal diversion occurred when India desperately needed heavy water for one of its nuclear reactors, then under construction. The fast nuclear breeder reactor at Kalpakkam, near Madras, has since been completed and one assumes that India's nuclear programme, open and not so open, is proceeding full speed ahead. However, the covert way of obtaining heavy water is only one of the clues to India's nuclear ambitions; there are several others, more manifest than this, including the 1974 testing of a nuclear device in the Rajasthan desert, barely 18 miles from Pakistan's borders. Another is New Delhi's consistently negative response to a number of proposals made by Pakistan to arrive at an understanding with India on the nuclear issue.

Last year, from two international forums, Prime Minister Junejo offered to India a regional, global or bilateral approach for a non-proliferation understanding. Addressing the United Nations General Assembly last June the Prime Minister proposed to his Indian counterpart a bilateral agreement to renounce nuclear weapons. Then, in November, speaking at the inaugural session of the South Asian Association for Regional Cooperation summit at Kathmandu the Prime Minister made a plea for a joint renunciation of the nuclear option by all SAARC members. On earlier occasions, too, Pakistan had proposed that the two countries throw open their nuclear facilities to international inspection or, in the alternative, agree to a system of mutual inspection.

Other proposals have included declaring South Asia a nuclear-free zone and an offer that Pakistan and India sign the NPT [Nuclear Nonproliferation Treaty] simultaneously. However, none of these suggestions evoked a positive response from the other side. Not only that, to cover up its own secret nuclear weapons project India mounted a high-pitch propaganda campaign against Pakistan's modest nuclear programme, accusing Islamabad of working towards an "Islamic bomb", a "bomb in the basement" and so forth. Luckily for India, it found some receptive ears in the west, especially in the United States, where some sections of the media and Congress have repeatedly pleaded for a suspension of aid to Pakistan on the unfounded charge that it was producing weapons-grade uranium at its Kahuta facility.

None of these tactics can serve to obscure from view India's own vastly ambitious nuclear programme which it has been feverishly pursuing with a helping hand from the two superpowers. From the Soviet Union it imports heavy water, besides having a number of agreements with Moscow on nuclear cooperation, while the United States has been generous in providing it not only with uranium but also with super-computers that could be used in the manufacture of nuclear weapons. American sources now estimate that by 1990 India will be able to produce enough weapons-grade plutonium to manufacture 60 nuclear bombs a year.

All this should be seen in the context of India's mounting defence expenditure, its vastly accelerated naval expansion programme, especially the acquisition of a nuclear-powered submarine (with more on the way), its military presence in Sri Lanka, its jingoistic stance towards Pakistan as exemplified by intrusions into the Siachen Glacier, and its overall perception of itself as the dominant power in the region and, perhaps, a superpower of the future. That a colossal amount of money should have been diverted into these military channels and away from the mounting needs of India's poverty-stricken people is indeed a sad reflection on the sense of priority of India's rulers of today. While all of India's neighbours, particularly Pakistan and China, with both of whom India has had border skirmishes and wars, are bound to take notice of New Delhi's nuclear ambitions and bloated armaments in the pursuit of hegemonic aims, the first to suffer are the people of India themselves.

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